GRAIN MARKETING IN THE SOVIET UNION

With Emphasis on Wheat

REPORT OF A TECHNICAL STUDY GROUP

Economic Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREWORD

An agreement was concluded on December 1, 1959, between the Governments of the United States of America and the Union of Soviet Socialist Republics providing for exchanges in the cultural, technical, and educational fields. This is the second such agreement; the first was concluded in 1958.

Agriculture, which plays an important role in the national economies of the two countries, was specifically included in the agreements as a field for exchange of specialists. The U. S. Department of Agriculture accordingly sent to the Soviet Union in 1960 four technical study groups of specialists in the following subjects: Handling, storage, and transportation of grain; food processing; agricultural information and planning; and soil salinity. In 1961 it is planned to send two additional study groups in the following fields: Poultry husbandry, and forage crops and range management.

The Soviet Union in turn sent to the United States in 1960 three delegations of specialists in the following subjects: Food processing; fertilizers, insecticides and weed killers; and agricultural science and information. In 1961 three additional Soviet teams are expected in the following fields: Poultry husbandry, breeding and hybridization of cattle and pigs, and mechanization of cultivation and harvesting of sugar beet and potatoes.

Each United States exchange study group, on completion of its assignment, prepared a report for publication. The grain exchange group composed of V. John Brensike, Chairman; Leo E. Holman, Lawrence Zeleny, Agricultural Marketing Service; John C. Cowan, Assistant to the President, Dannen Mills, St. Joseph, Mo.; Roy K. Durham, Technical Consultant to the Flour Milling Industry, San Francisco, Calif.; Eugene T. Olson and Raymond E. Vickery, Foreign Agricultural Service, has prepared two reports. The first, Grading and Exporting Wheat in the Union of Soviet Socialist Republics, was prepared by Raymond E. Vickery, Foreign Agricultural Service, and Lawrence Zeleny, Agricultural Marketing Service, with the assistance of the other members of the delegation. The second, Grain Marketing in the Soviet Union, With Emphasis on Wheat, was prepared by V. John Brensike assisted by the other members of the delegation.

Reports on the 1958 exchanges have been published under the following titles: Soil and Water Use in the Soviet Union, Economic Aspects of Soviet Agriculture, Cotton in the Soviet Union, Veterinary Science in the Soviet Union, Crop Research in the Soviet Union, Farm Mechanization in the Soviet Union. The 1959 reports in processing stage are Entomology in the Soviet Union, Livestock in the Soviet Union, and Forestry and Forest Industry in the USSR.

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GRAIN MARKETING IN THE SOVIET UNION WITH EMPHASIS ON WHEAT

Report of a Technical Study Group

INTRODUCTION

Our technical exchange team arrived in Moscow on June 28, 1960, and departed from Moscow on July 27, 1960. During the 29-day period we visited the operations at 1 Sovkhozy (State) and 2 Kolkhozy (collective) farms; 3 grain elevators and 7 milling combines located in areas as widely separated as Leningrad in the north; Moscow in the central part of European Russia; Kiev and Odessa in the Ukraine; Novorossisk, Krasnodar, and Sochi in the Northern Caucasus; and Kustanai in the New Lands of Asia (fig. 1). In addition, we talked to 9 State Krai, and Oblast committees responsible for some phase of grain marketing and visited 7 academies, schools, and research institutes (see itinerary, page 57.)

The objective of our team was to study grain handling, storage, and processing operations and research in the Soviet Union. For this reason the composition of the 7-man team included agricultural economists with general marketing interests, an agricultural engineer, a flour milling specialist, and a specialist in grades, standards, and inspection.

We obtained considerable information on grain marketing operations and research at each of our stops. But the vastness of the country, the broadness of our topic, the vast differences in our economic and marketing systems, the shortness of each stay, and in some areas the lack of overall statistics made it difficult to get a complete picture of grain marketing in the Soviet Union.

In general, the group felt that we were given an extensive tour of our area of interest even though we were excluded from certain "closed" areas. We were not permitted to see a plant manufacturing grain handling and milling equipment. Only a farm machinery manufacturing plant was included which we chose not to visit. We saw both small and large operations, some with very efficient facilities and some much less efficient. Not knowing the industry in the USSR, we could not determine whether what we saw was representative or not. However, some of the information presented later may help the readers of this report to make their own decisions in this respect. Some changes and additions to the itinerary were permitted during the tour as new areas of questioning arose. 1/

The "ruble", a monetary unit used in the Soviet Union, is either referred to directly in the text or is converted to U. S. dollars. In either event these data refer to the "ruble" used in the Soviet Union prior to 1961 and not to the "new ruble" now in use.

The team was received warmly at each stop in our visit. The Soviet people, especially the farmers, were very much interested in Americans; were very hospitable; they treated us with kindness and consideration. They appeared to be trying to answer all of our questions and they supplied us with much of the information promised to us during our trip. The exceptions appeared to be in areas such as wheat, corn, and other grain utilization and disposition where the Soviets appear either to have little or no information or they are reluctant to discuss the matter.

The team was impressed with the way the Soviet scientists appear to keep up to date on foreign literature in their fields

1/ The team wishes to acknowledge the valuable assistance given to them by the staff of the American Embassy, especially Mr. William Horbaly.

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Figure 1.--Map of the Soviet Union, Itinerary, and New Lands Area.

of endeavor. These impressions may have been magnified by (1) the reprints in 4 to 6 foreign languages of each of their main magazines and newspapers, and (2) having to get technical questions and answers translated by an interpreter.

BACKGROUND

For many years the major Soviet agricultural objective has been that of expanding production of food and fiber. Large increases in production were necessary from the low postwar levels to meet the needs of the growing population and to provide supplies for stocks and export in economic competition with the West.

This objective is still predominant; however, it seems to be shifting somewhat. The Soviets desire a better diet for their people. This was stressed in nearly all of our conversations especially when stated as a desire to catch up with the United States in the per capita production of livestock and poultry products. Currently, per capita consumption of meat and poultry is about one-third that in the United States. Their desire to surpass U. S. per capita production is emphasized in their newspapers, displays, and billboards, in both the rural and the urban areas. The fact that the population of the Soviet Union is not only growing rapidly at present (about 3.5 million per year), but also is becoming increasingly urbanized with the industrial development of the country (table 1) accentuates the need for greater farm output. Urbanization not only decreases the manpower on farms, but it normally brings with it a desire for higher quality diets. These diets require increased supplies of animal and dairy products, sugar, vegetables, and fruits. Political and psychological factors also have made more urgent the long promised improvement of living levels. 2/ Thus, the agricultural problem in the Soviet Union offers quite a contrast to our U. S. problem of surplus agricultural production. In the Soviet Union it is a battle for larger crops and more livestock.

Our exchange team was told that as yet Russia has no problem in having excess workers in agriculture although the problem must be becoming important. They have no program or plan to move workers from agriculture to the cities other than through education and normal transfers.

The total land area in the Soviet Union is about 8,600,000 square miles or nearly three times the size of the United States. Although much of this area is not suitable for farming, the Soviet Union had a cropped area of more than 501 million acres in 1960 as compared to 333 million acres in the U. S. This sown area is confined largely to a so-called "fertile triangle." The base of this triangle stretches from Leningrad on the Baltic Sea, along the western border to the Black Sea in the South, and the apex is near Krasnoyarsk in Central Siberia. This triangle is bordered by forests and tundra, mountain ranges, and deserts. Thus, much land within the triangle is unsuited or ill-adapted to farming.

Even in the better farming areas climate places serious limitations on agricultural production. Much of the area is characterized by a cool continental semiarid climate similar to that of the spring wheat region of the Prairie Provinces of Canada and the Dakotas of the United States. The western part of the Fertile Triangle is less continental than interior North America; it has slightly milder winters and a longer growing season than American areas with similar summer temperatures. 3/

2/ Agricultural Research Service Economic Aspects of Soviet Agriculture. U. S. Dept. Agr. unnumbered publication, 78 pp., May 1959, p. 2.

3/ Harris, Chauncy D. Soviet Agricultural Resources Reappraised Jour. Farm Econ. 38: #262, 264. 1956.

Table 1.--Population of the Soviet Union, total, rural, and urban, selected years 1/

Year	Total population	Rural		Urban	
		Number	Percentage of total	Number	Percentage of total
	Million	Million	Percent	Million	Percent
1926 2/	147.0	120.7	82.1	26.3	17.9
1939 3/	170.6	114.5	67.1	56.1	32.9
1956 4/	200.2	113.2	56.6	87.0	43.4
1960 5/	212.3	108.3	51.0	104.0	49.0

1/ Source: P. 19 of USSR Council of Ministers Central Statistical Board. Forty Years of Soviet Power in Facts and Figures. 319 pp., illus., Moscow, 1958. (In English; translated by Foreign Languages Publ. House, Moscow.)
2/ Census of December 17 for prewar territory.
3/ Census of January 17 for prewar territory.
4/ Estimate as of April 1 for the present territory.
5/ Estimated as of January 1 for the present territory.

The geographical location of the Soviet Union helps to explain the severity of its climate. Yalta at the southern tip of the Crimea, is approximately in the same latitude as Rochester, Minn. The growing season is about 130 days in the vicinity of Moscow, 190 days near Krasnodar, and about 120 days in the "New Lands" area in Asia. The severe and long winters and the short growing seasons limit the choice of crops and varieties in many areas. This may also unfavorably affect yields per acre. For example, fall sown grains, especially winter wheat, can not be produced in many of these areas.

Soviet agricultural production is also hampered by low rainfall in many areas. Annual precipitation in the central and western parts of the country is 20 to 25 inches. The northern European part of the country suffers more often from an excess of moisture. Precipitation is light in the southern and eastern agricultural regions of the Soviet Union--less than 16 inches annually. Even with the heavy snows, annual precipitation in the Kustinai area of the "New Lands" is only about 12 inches. In the late spring and early summer, droughts frequently occur in the southwestern European part of the USSR (usually exclusive of the Kuban or Krasnodar regions) and a large part of the adjacent Kazakhstan and southern Ural regions. These droughts are often aggravated by scorching winds, the so-called "sukhovei". During the spring and early summer of 1960 these conditions were reported and even in the Krasnodar Krai we were told about some losses of winter wheat acreage due to the early drought and dust storms. Apparently the small losses reported to us were understated or at least they must have been greater in other areas adjacent to the Krasnodar Krai since we noticed a number of articles in newspapers which indicated that the wheat yields were lower than expected in this area.

Land Utilization

Farm land in the Soviet Union appears to contain much forest and brush land,

and land unsuitable for agriculture. Wheat, grasses, rye, corn, and oats in about that order occupy most of the plow land in the Soviet Union (table 2).

The Soviet Union produces much more food grains but much less feed grains than we do in the United States. Their production of wheat and rye is more than twice our production but their production of the major feed grains is less than one-half of our production of these same crops. For example, in 1957 feed grain and by-product feed production in the Soviet Union would feed less than one-third as many grain consuming animal units as the comparable production in the United States. 4/

The Soviet Union has been the world's largest producer of wheat since 1948, though its production fluctuates widely from year to year. Both acreage and production have increased sharply since World War II--acreage about 50 percent and production about 75 percent.

Winter wheat production is centered in the older European areas of the Soviet Union, the Ukraine, and the Kuban (table 3). Spring wheat production is primarily located in the "New Lands" area of Asia and the Ural region (fig. 1). These "New Land" areas are said to have been producing wheat in quantity since 1954.

The Soviets attempted to use scientific methods in opening the New Lands area to the production of wheat and other grains. They apparently used agricultural students during extended summers to obtain soil tests of each acre of land in this large area. In opening this area for production, they have put only the chernozem or black soil area under the plow. They also indicate that they use a 5-year rotation system, although they admit varying from it as National Goals demand. They also admit they are keeping track of the possibilities of wind erosion. So far they claim that none has occurred in this area. The New Lands area produces between 40 and 50 percent of the total wheat production in the Soviet Union and nearly all of the spring wheat. It has a very short growing season (farther north than North Dakota) and receives an average of 11.8 inches of rainfall a year. It was reported that most of the past increase in acreage had been in this area but that future increases in crop acreage would occur primarily in the older areas as a result of drainage and irrigation. The New Lands area probably will continue to become more and more important in wheat production since the old bread basket of the Ukraine and Northern Caucasus is expected to shift more toward the production of corn for grain and high protein yielding crops.

The production of rye points out a major difference in the cropping patterns of the USSR and the United States. Rye is a hardy, fairly drought resistant crop that is adapted to soils of low fertility. It has been a major crop in Soviet agriculture for many years although recently it has been decreasing in importance. Fall seeded (winter) rye is predominantly grown in the northcentral, and the eastern regions of European Russia.

Another major difference in the cropping patterns of the Soviet Union and the United States has been in the production of corn (table 4). Corn was a minor crop in the Soviet Union until 1955. Since then corn acreage has increased considerably. Corn in the Soviet Union still plays a much more minor role than it does in the United States. Most of the corn is grown for silage and as a fodder crop in areas where corn will not mature. The increases in corn acreages have occurred primarily in the Ukraine and Northern Caucasus regions. These areas seem fairly well suited for corn for grain. Climatic conditions in these areas, however, are not so favorable as they are in our corn belt.

Increases in the acreage planted to corn have been the result of recent Government programs designed to increase the production of livestock, poultry, and their products. The urgent need for feed crops may have resulted in the planting of corn in areas where other forage crops may

4/ See p. 23 of reference cited in footnote 2, p. 3.

Table 2.--Acreages sown to selected crops in USSR, 1950 and 1954-57

Crop	1950	1954	1955	1956	1957	1959
	Million acres	Million acres	Million acres	Million acres	Million acres	Million acres
Winter wheat	30.9	38.8	45.2	31.9	46.0	43.0
Spring wheat	64.2	83.0	104.3	121.3	124.8	112.6
All wheat	95.1	121.8	149.5	153.2	170.8	155.6
Rye	58.3	50.7	47.2	45.5	45.0	42.3
Barley (winter)	1.0	1.0	1.5	1.5	1.5	3.4
Barley (spring)	20.3	25.5	23.0	27.9	22.7	20.4
Oats	40.0	39.3	36.6	37.3	34.6	35.4
Corn for all purposes 1/			44.2	59.1	45.2	55.4
Corn for grain	11.9	10.6	22.5	23.0	14.3	21.5
Buckwheat	7.4	6.9	6.9	6.7	6.2	3.3
Millet	9.4	13.6	19.0	15.8	8.9	6.7
Sunflowers	8.9	10.0	10.5	11.1	8.6	9.6
Cotton	5.7	5.4	5.4	5.1	5.2	5.3
Potatoes	21.3	21.5	22.5	22.7	24.2	23.6
Flax for fiber	4.7	2.7	3.7	4.7	4.2	4.0
Sugar beets for sugar	3.2	4.0	4.3	5.0	5.2	6.8
Total, above crops	287.2	313.0	374.3	395.6	382.3	371.8
Annual grasses including corn for green feed	17.3	23.2	36.3	51.4	50.2	63.2
Perennial grasses	27.7	39.8	33.9	30.4	32.4	37.5
Total, grasses	45.0	63.0	70.2	81.8	82.6	100.7
Total, above crops and grasses	332.2	376.0	422.8	441.3	434.0	438.6
Total, all crops 2/	361.5	410.5	459.1	481.1	478.6	485.1

1/ Data prior to 1955 not separated into corn for grain and corn for all purposes. Acreage sown for purposes other than grain considered to be small.
2/ Excludes corn for all purposes; includes corn for grain.

still provide more feed per acre. To date the increase in corn acreage has not occurred at the expense of the food crops, but it may do so at a later date. Acres formerly used for oats, barley, grasses, and summer fallow have provided much of the acreage now used for corn.

Production Goals

The Soviet Union's production goal plan calls for a reduction in the per capita consumption of grain and grain products from 363 lbs. to 330 lbs. by 1965 (see table 9). Per capita consumption of

poultry, livestock, meat, and eggs is expected to increase considerably because of their effort to improve the diet of their people and their hope of eventually overtaking the United States in this respect.

Despite the planned decrease in per capita consumption of grain and grain products, the State is calling for a further increase in wheat production. The 1965 goal calls for a production of from 76 to 84 million tons. The lower limit approximately equals their record 1958 harvest.

The 1965 goal for the total grain harvest is 164 to 180 million tons in contrast with the reported 1958 harvest of 141.2 million tons. This of course reflects the need for more feed grains to help make possible the high poultry, livestock, meat, and egg goals. An even bigger problem in this respect is the need for additional high protein feeds. Production goals for sunflower (the major source of protein) flaxseed, cottonseed, and sugar beets all call for sizable increases.

Table 3.--Wheat acreage by regions, Soviet Union, 1953 and 1959 1/

Region	1953	1959
	1,000 acres	1,000 acres
RSFSR: 2/		
Northern Raion	331	158
Northwest Raion	598	252
Central Raion	2,538	1,698
Volga-Vyatskup Raion	2,140	1,512
Central Black Soil Raion	6,244	4,598
Transvolga Raion	15,105	14,920
North Caucuses Raion	13,195	11,147
Ural Raion	14,115	17,720
Western Siberia Raion	14,188	24,567
Eastern Siberia Raion	4,174	6,560
Far East Raion	1,003	1,591
Total RSFSR	73,631	84,723
Ukrainian SSR	23,583	18,624
White Russian SSR	1,102	465
Uzbek SSR	1,599	1,376
Kazak SSR	11,461	44,567
Georgia SSR	1,119	566
Azerbaijan SSR	1,213	1,329
Lithuanian SSR	791	341
Moldavian SSR	1,512	1,201
Latavian SSR	556	220
Kirgiz SSR	1,035	959
Tadzhik SSR	823	638
Armenian SSR	677	427
Turkmen SSR	101	106
Estonian SSR	284	124
USSR	119,487	155,666

1/ Sel'skoye Khoziaistvo SSSR,(Agriculture, USSR) Moscow, 1960, pp. 150-151.
2/ Russian Union of Federated Socialist Republic.

Table 4.--Corn acreage by regions, Soviet Union, 1953 and 1959 1/

Region	1953	1959
	1,000 acres	1,000 acres
RSFSR: 2/		
Northern Raion	---	2
Northwest Raion	---	94
Central Raion	---	917
Volga-Vyatskup Raion	---	608
Central Black Soil Raion	215	4,211
Transvolga Raion	25	5,256
North Caucuses Raion	1,762	8,233
Ural Raion	7	3,931
Western Siberia Raion	5	3,353
Eastern Siberia Raion	---	954
Far East Raion	25	331
Total RSFSR	2,039	27,890
Ukrainian SSR	4,351	19,000
White Russian SSR	---	719
Uzbek SSR	67	494
Kazak SSR	99	3,553
Georgia SSR	862	887
Azerbaijan SSR	25	351
Lithuanian SSR	---	141
Moldavian SSR	1,075	1,680
Latavian SSR	---	67
Kirgiz SSR	84	294
Takzhik SSR	7	133
Armenian SSR	2	57
Turkmen SSR	---	94
Estonian SSR	---	25
USSR	8,611	55,385

1/ Sel'skoye Khoziastvo SSSR,(Agriculture, USSR) Moscow 1960, pp. 156-157.
2/ Russian Union of Federated Socialist Republic.

Type and Size of Farms

Farms in the Soviet Union are huge, both in land area and labor force. All land was collectivized during the early 1930's and all agriculture has been collectivized or operated in state farms with the exception of small household plots.

Practically the only remnant of small peasant farming is the small kitchen garden plots and a few head of livestock, which some families in collective and state farms are permitted to possess. Such farming accounts for only 3 to 5 percent of the total land area, but for a much larger proportion of the livestock population, including more than half of the cows. Characterized by intensive farming, and linked with a limited free retail market in the nearby cities, the private sector makes a highly significant contribution to the national food supply and to the peasants' incomes.

The large farming units in the Soviet Union are of two types, the kolkhozy (collective farms) and the sovkhozy (state farms). There are about 53,400 collective farms in the Soviet Union and they account

for about two-thirds of the total cropland (tables 5 to 7). By 1959 these collective farms averaged about 5,720 acres under crops and about 340 peasant families. There are about 6,500 state farms which account for the remaining sown area and average about 16,000 acres in crops.

The collective farm, or kolkhozy, consists of pooled small farms formerly independent. Theoretically, a kolkhozy is supposed to be a sort of a producers' cooperative, electing its own management, but actually it has become tightly controlled by the Soviet state and Communist Party authorities. Unlike the workers in the state farms, however, members of collective farms, did not receive regular wages for their work. They were, with some exceptions, residual sharers in the income of the collective after the claims of the State and production expenditures had been met. Such earnings varied in proportion to the skill and labor of the peasants. The latter is evaluated in so-called "work days," which are really arbitrary units set up to rate the performance of certain standard daily tasks or operations, and to provide a basis for distribution of income in farm produce and in cash. The greater the skill required, the larger the number of work days allowed for a satisfactory performance of a standard task (determined by comparisons with predetermined norms) the greater the earnings of a collective farm member. Steps are being taken at present to reform and simplify the cumbersome "work day" system of payment into one which is called a "guaranteed monthly cash wage."

Until recently collectives were not permitted to own tractors and other complicated modern machinery. Such equipment was owned by State machine-tractor stations (MTS), which serviced collectives for stipulated fees in terms of farm produce and also performed important farm supervisory functions for the government. However, in accordance with a new government policy promulgated in the spring of 1958, machine-tractor stations have been selling most of their machinery to collectives. Thus, machine-tractor stations have gradually been converted into repair and supply centers for machinery, spare parts, fuel, etc.

The State farm, as the name implies, has always been owned and operated directly by the State. Farm workers are paid regular wages which are reported to be just like wage payments in industry, and on the average, approximate the income of the collective farm workers. The State farm has been gaining in importance in recent years primarily due to the expansion of acreage in the "New Lands."

Our exchange group was told (but some conflicting evidence was noted) that the Government is making no effort to increase the role of either collective or State farms in their agriculture industry. Likewise, we were informed that although they have made few studies of the optimum size of farms, they believe that these optimums vary by type of farm and that the Government is satisfied with the current sizes.

PLANNING THE GRAIN MARKET

Wheat production and marketing in the Soviet Union, like all other aspects of the country's economy, are Government directed. The State owns all the means of production, including land and equipment. The management and the workers are directed by the central authority to achieve predetermined goals.

At the top level, this planning for production, domestic utilization, and export of wheat is coordinated by the State Planning Committee (Gosplan) and the Council of Ministers. This committee is responsible for the comprehensive studies of the national economic requirements, including foreign trade, and for working out the current and long-range plans.

The Ministry of Agriculture is responsible for academies, colleges, institutes,

and research relating to agriculture. It is also responsible for the grain production on the collective and state farms, where all the wheat is grown.

When the national acreage and production goals are established for a given year, they are broken down into goals for each of the Republics. Then they are further broken down into individual goals for each krai or oblast. An oblast is the smallest administrative-territorial division of Government, cities and towns are excluded as divisions, probably comparable to our large counties. A krai is an even larger area containing some land not in an oblast but also at least one operating oblast.

Table 5.--Distribution of area sown to crops by kind of farms, as percentage of total, Soviet Union, in selected years 1/

Kind of farms	1928	1940	1950	1955	1957	1959
	Percent	Percent	Percent	Percent	Percent	Percent
Collective farms (kolkhozy)	1.2	78.3	82.7	80.18	68.39	66.29
State farms and other State enterprises	1.5	8.8	10.9	15.8	27.9	30.0
Private holdings of kolkhozniki 2/	1.0	3.0	4.0	3.1	2.8	2.7
Workers and salaried personnel	--	.5	1.1	.9	.9	1.0
Individual peasant farmers	96.3	9.4	1.3	.02	.01	0.01
Total	100.0	100.0	100.0	100.0	100.0	100.0

1/ Data from official sources.
2/ Members of collective farms.

Table 6.--Percentage distribution of collective farms by sown area, USSR, and selected regions, 1956 1/

Sown area	All USSR	Northwestern	Northern Caucusus	Western Siberia
	Percent	Percent	Percent	Percent
500 hectares (1,236 acres) and under	17.8	64.2	22.6	5.4
501 to 1,000 hectares (1,238 to 2,471 acres)	24.7	25.9	6.7	5.8
1,001 to 2,000 hectares (2,473 to 4,942 acres)	29.0	9.3	7.5	17.9
2,001 to 5,000 hectares (4,944 to 12,355 acres)	22.5	.6	28.3	46.5
Over 5,000 hectares (12,355 acres)	6.0	--	34.9	24.4
Total	100.0	100.0	100.0	100.0

1/ Source: Narodnoe Khoziaistvo SSSR v 1956 Godu, p. 143.

Table 7.--Percentage distribution of collective farms by number of households, USSR and selected regions, 1956 1/

Number of households	All USSR	Northwestern	Northern Caucusus	Western Siberia
	Percent	Percent	Percent	Percent
100 and under	19.0	61.6	9.2	17.3
101 to 200	34.3	33.2	24.4	44.4
201 to 300	20.7	4.4	20.6	25.0
301 to 500	17.6	.7	18.9	12.3
Over 500	8.4	.1	26.9	1.0
Total	100.0	100.0	100.0	100.0

1/ Source: Narodnoe Khoziaistvo SSSR v 1956 Godu, p. 142.

Somewhat concurrently with this breaking down of the National goals, the individual State and collective farms prepare their farm plans. In doing so they of course keep both their own resources and the trend in the national goals in mind. Somewhere these farm plans and the break-down of the national goals come together. In case of differences the farm plans are altered or possibly both the farm plans and the Government goals are changed.

The State Committee for Grain and Grain Products has the responsibility for collecting grain from the farms, storing, distributing it to State-owned processing facilities such as mills and bakeries, and delivering it to retailers and to ships for export. In addition this committee is in charge of grain inspection, grading, and standardization, and the distribution of seeds for all new varieties and some old varieties. It carries on these tasks through the Ministries for Grain and Grain Products in the 15 Soviet Republics. These Ministries in turn, direct the activities of the krai or oblast directors of the local Grain and Grain Products Committee.

Elevators, and flour and feed mills and the equipment necessary for these facilities are designed by (Promzernoproyekt) The State Planning Institute for Flour Milling and Groats Enterprise, Elevators, and Warehouses. Variations of typical or model designs are made to fit local needs upon request by local units of Government. This organization also assists in planning the location of the facilities. We were told that the local government need not follow these plans but they generally do. The local governments must finance the construction and pay a designing fee to the agency through loans obtained from the State Bank.

The export plans are made, within the national goals as established by Gosplan, by the Ministry of Foreign Trade and are implemented by the "Exportkhleb," the grain export corporation. This organization also handles imports for all grains, including rice, oilseeds, and related products.

Marketing Channels

Grain marketed for flour production or export in the Soviet Union is collected first at a collection point elevator. It is hauled by truck; lack of sufficient trucks was reported in some areas. This collection point elevator receives, grades, pays the farm, cleans, dries, stores temporarily, and ships the grain. Prices received by the state and collective farms are established prior to marketing. These

prices provide premiums and discounts for moisture, and in some areas of the country vary 2 to 3 rubles from, for example, a 60 ruble per centner ($1.62 per bu.) price for wheat, depending upon crop size. If the collection point elevator has a railroad or waterway location it ships directly to the West on the order of the Grain and Grain Products Committee. These orders are generally given one month before shipment. If the elevator does not have shipping facilities on railroad or water, it ships to a transhipment elevator for later shipment to the export or milling combine of final use. None of the elevators visited reported storing grain for more than a year so the grain carried over from one year to another was only the normal working stocks. 5/ Thus no opportunity was provided to estimate the size of the wheat or grain carry-over in the Soviet Union.

Grain marketed for seed and feed does not move through these same channels. Most feed crops are used on the farms where they are produced and the handling of grain that moves off is usually much like a custom feed milling operation. That is, it is shipped to a feed mill for grinding and mixing with a few other ingredients and is then returned to the farm in a mixed feed.

Seed marketing is much more complicated. Hybrid seed corn moves directly from the special farm producing it to a seed corn processing plant for drying, selecting, and calibrating according to kernel size and shape (to assure 2 kernels per hill) before being distributed for use by the Grain and Grain Product Committees. Most wheat seed, sortoviye, (that for established varieties) is taken from a crop and retained and used on the same farm, except that after 4 years the "sortoviye" must be replaced by "elite" seed to restore the trueness-to-type. The elite seeds are produced on special farms for 300 percent of the going price for that crop and may not only be seed to establish new varieties but also to replenish an old variety's trueness-to-type. Elite seed moves from the producing farm to the Grain and Grain Products Committees for final distribution. 6/

Geographical Distribution

The geographical distribution of the marketed portion of the grain crops is difficult to determine on the basis of a single trip because it varies from year to year as crop size varies in the supply areas. For example, in 1956-57 much of the Leningrad wheat receipts came from the "New Lands." In years since then little has come to Leningrad from this area. Currently, wheat from the "New Lands" appears to move towards the central European part of the Soviet Union except for the amount scheduled for export.

Procurement and Prices

The State takes title and the Committee for Grain and Grain Products handles the distribution of all the grain receipts at the assembling elevators except that which may be cleaned, dried, ground, or processed for the use of the State or collective farm. Most of the grain used on the farm is retained on the farm and never comes to the elevator. The State takes all the wheat produced on state farms except what is utilized on the farm.

The size of the quota, in proportion to production, depends upon the total production and the need. Also, collective farms can deliver quantities in addition to the quotas. In earlier years higher prices were paid for above quota deliveries. For example, in 1957, the

5/ This does not mean that the Soviet Union currently has no grain carried over. There are some intermediate elevators which may carry over stocks.

6/ They are planning to begin extension work in krais and oblasts to help get new seeds and practices adopted more rapidly.

Table 8.--Wheat collected by the State from the collective farm production, selected years

Year	Production	Collection	Proportion of production collected
	Mil. bu.	Mil. bu.	Percent
1940	1,167	575	49
1950	1,142	555	49
1953	1,516	705	47
1956	2,416	1,367	55
1957	2,135	940	44
1958	2,313	1,548	55
1959	2,539	1,255	49

price for quota wheat was 27 rubles per centner (73 cents per bu.) and the price for above quota deliveries was 110 rubles per centner ($2.98 per bu.). 7/

In 1959 the base price generally reported in the Ukraine and the Krasnodar Krai was 60 rubles per centner ($1.62 per bu.). This price, with discounts and premiums for moisture, was paid for all wheat delivered either under or over the quota. In Kustanai (Asian New Lands) deductions were made for wheat with more than 15.5 percent moisture and premiums for less moisture. In the Ukraine and the Krasnodar Krai the comparable figure was 14.0 percent moisture. These premiums and discounts were generally one percent change in price for one percent more or less of moisture.

The comparable price for corn was 46 rubles per centner. The price for "elite" corn, wheat, and other grain seeds was generally 300 percent of the going price for the respective crop. All farms were interested in becoming a part of the "elite" seed production program.

These base prices vary by major zones within the Soviet Union along with changes in the costs of production. Region designations and price variations were not supplied to us, but the New Lands area was pointed out as the area of lowest production costs for wheat.

The farm managers appear to favor the current system of pricing.

Transportation

We had little opportunity to study transportation, but general observations seem warranted in this summary of grain marketing.

Farm buildings did not appear to have been located with any idea of minimizing travel or hauling. Some of the on farm hauling was done with horses and wagons. Many farms are located a long distance from railroad facilities, the major improved means of transportation. The unimproved roads from farms to urban areas and grain elevators become almost impassable during periods of rain or snow. In general, only the arterial roads connecting major cities are said to be satisfactory, although much grading and improving is in progress on the farm roads. The improved roads are chiefly blacktop pavement. The remainder are dirt roads, some are graded, and some are just trails.

Grain is transported in bulk from farms to elevators by road trucks (lorries) with capacities of 3 to 5 tons each. Four

7/ Agricultural Research Service. Economic Aspects of Soviet Agriculture. (U. S. Dept. Agr.) Unnumbered Pub., 78 pp., May 1959.

wheeled trailors are often pulled by these trucks. We did not see semi-trailers being used for hauling grain. Grain is trucked from a radius of up to 50 kilometers (30 miles).

Grain moves by rail or water from collection points to mills or port elevators. Rail cars hold 2,200 bushels of wheat and no hopper bottom cars are used. Barges have a capacity of 36,700 bushels for wheat; they are equipped with permanent metal covers. We were told that there never is a shortage of rail cars or barges as shipment is planned for a month in advance. No intransit privileges are needed in the Soviet marketing system.

One example of a typical freight rate was a rail rate of 70 rubles per ton to ship grain some 2,200 miles from Kustanai in the New Lands to Moscow. It was pointed out that generally such shipments were made over a combined rail and water route.

Lack of good transportation handicaps farm operations but even more important, it hinders specialization. For example, the "New Lands" area which is the lowest cost wheat producing area, must use land to produce corn, other feed grains, and livestock for its own population (100,000 people in Kustanai). The corn we saw was only 18 inches high with only 4 to 5 weeks of growing season remaining. Even for silage its economic value could not equal that of the wheat sold. The lack of adequate transportation also retards the development of an efficient system for marketing agricultural products.

Likewise, as the farms are farmed more intensively, the transportation problem becomes even more urgent. Intensive farming also requires the use of more machinery, fuel, insecticides, herbicides, fertilizers, and other supplies which must be delivered in greater volume.

Specialization of livestock, food grains, horticultural crops, and so on would become possible with increased transportation and refrigeration. Greater variety in the human and animal diets would be possible if more transportation and refrigeration become available.

Until such a time, however, the transportation problem in the Soviet Union appears to be destined to remain a deterrent to increased output from intensive farming.

GRAIN USAGE OR DISAPPEARANCE

Our team made numerous efforts to obtain data on the usage or disappearance of grain in the Soviet Union. Apparently, little or no information of this type is collected. What information we obtained indicated that (1) most of the corn is harvested as silage and green fodder, only a small proportion of the total crop is harvested as grain; and (2) most of the wheat is used for flour, some is used for feed and perhaps 4 or 5 percent is exported.

Soviet officials told us that there will be a continued effort to reach the 180 million ton grain production goal by 1965. They intend to achieve this goal by more intensive agriculture rather than through acreage expansion as they did in the 1954-60 "New Lands" program. To increase yields they except to increase their use of fertilizer, insecticides, and herbicides which currently are not being used as extensively and intensively as in the United States. But, the Soviets appear to be placing even greater emphasis on the use of better yielding varieties. We visited several research institutes which appear to be doing a good job in this area.

The 1965 goals call for an increase in the per capita consumption of livestock and poultry from 42 in 1959 to 70 kilograms by 1965. They also indicate that the per capita consumption of flour

should drop from 165 kilograms (363 lbs.) to 150 kilograms (330 lbs.) in 1965. Population increases and a planned decrease from the 78 percent extraction rate may require small increases in flour production during the same period.

The Soviet Union's drive for more livestock and livestock products, in trying to match or exceed the United States, should change the pattern of grain production and disposition. A rather sharp increase in feed grain production can be expected during the next few years, accompanied by a more modest increase in the production of food grains.

Table 9 indicates the approximate per capita consumption of flour and grain in the Soviet Union based upon the assumptions that (1) 85 percent is wheat flour and 15 percent rye flour, and (2) that the extraction rate for wheat is 78 percent and for rye about 90 percent.

Table 9.--Estimated flour and grain consumption, per capita, 1959, and of the 1965 goal

Type of flour	Grain		Flour			
	1959	1965	1959		1965	
	lbs.	lbs.	kgs.	lbs.	kgs.	lbs.
Wheat and rye	455	415	165	363	150	330
Wheat	395	360		309		280
Rye	60	55		54		50

EXPORTS

Wheat from the USSR is exported by the State Export Grain Corporation, or Exportkhleb. This corporation is, in effect, an operating branch of the Ministry of Foreign Trade. Its job is to export the quantity of grain that the State Planning Committee (GOSPLAN) decides upon.

The Corporation's central office is located in Moscow, and representatives are stationed in the major ports of the country. Their job is to accept the grain from the State Grain Committee, which controls all grain movements in the USSR, and to see that the grain is loaded aboard ships in accordance with contracts with foreign buyers.

Total wheat exports from the USSR have increased substantially in the past few years. In 1959, there were 6,018,000 metric tons compared with an average of 677,204 metric tons in 1934-38. It is interesting to note the wide fluctuation from one year to the next.

USSR exports outside of Soviet Bloc countries have increased from 385,300 metric tons in 1938 to 1,682,700 metric tons in 1959 (table 10). Shipments outside have increased each year except 1957 when there was a small crop. Exports to satellite countries have increased substantially but fluctuations have been greater.

Overseas representatives are stationed in the major importing countries of Western Europe including the Netherlands, Belgium, Denmark, West Germany, and the United Kingdom. These representatives are attached to the Russian embassies, and are in fact a part of the trade section of the embassy. In countries where the "Exportkhleb" does not have

Table 10.--Wheat: USSR exports to Soviet block and non-bloc countries, average 1934-38, annual 1938 and 1955-59

Year	Soviet Bloc countries	Non-Bloc countries 1/	Total
	Metric tons	Metric tons	Metric tons
Average:			
1934-38	--	--	677,204
Annual:			
1938	--	--	1,275,870
1955	1,650,500	385,300	2,035,800
1956	547,600	904,800	1,452,400
1957	4,573,400	877,400	5,450,800
1958	2,836,500	1,042,200	3,876,700
1959	4,335,300	1,682,700	6,018,000

1/ Primarily Western Europe.

a representative, the trade section of the embassy represents the Khleb in all transactions.

Wheat is offered in the foreign markets by code number, which is the designation of the type, subtype, and class (class, subclass, and numerical grade in U. S. terminology) according to the USSR grain standards for wheat. For example, the Code 431 which accounted for almost all of the exports to Western countries in 1959 refers to Type 4, Red Winter; subtype 3, and Class 1. 8/

All exported wheat carries a Soviet State Grain Inspection Certificate printed in both Russian and English. In addition to the required entries "klyeikovina" or percent of wet gluten, is reported upon request. Officials stated that it is determined for all wheat exported and requested on about 30 percent of all exports.

Soviet export standards permit a maximum of 14 percent moisture, 2 percent foreign material of which 1 percent may be other grains and a minimum of 800 to 820 grams per liter. They emphasize that their export wheat exceeds these requirements. For example, they say that all wheat is recleaned prior to export to between 0.2 and 0.5 percent foreign material.

Export officials stated that prices are based on the London market and in the opinion of the Khleb are usually slightly lower than prices of comparable quality wheat from the United States and Canada.

If the farms receive an average of 63 rubles per centner ($4.29 per bushel) for their wheat and domestic mills are charged an average of 83 rubles ($5.65 per bushel), or 830 rubles ($207.50) per metric ton, for the wheat they grind, it might be reasoned that wheat going into the export market is also worth at least 830 rubles per ton (table 11).

With the cost of production and shipping disregarded once the decision has been made to export, it becomes extremely difficult to evaluate possible future exports of a country. Internal and external political considerations become paramount.

Soviet officials emphasized that priority for the increased production of wheat (in the order listed) would be:

(1) Food for increased population

8/ See section on Grain standards for definitions of subtype and class.

Table 11.--Wheat: Assumed value per metric ton of exports, compared with price received in 1959

Item	Rubles	U. S. dollars 1/
Assumed value	830	207.50
Average price received, f.o.b. USSR ports	286	71.50
Difference	544	136.00

1/ Converted at rate of 4 rubles per dollar.

(2) Lower extraction rate
(3) Feed for livestock and poultry
(4) Increase in stocks or planned carry over
(5) Exports

The planned reduction in per capita consumption should approximately offset the annual increase of about 3.5 million persons per year. This in effect leaves two domestic needs (1) feed (including extra tonnage from the lower flour extraction rate), and (2) increase in stocks. These domestic needs plus exports will influence plans for an increased production of wheat.

If the planned increase in wheat production is obtained and a new and higher production plateau is achieved by 1965, the potential for Soviet exports will be considerably increased unless feed needs become very great. And, should political demands dictate it, Soviet exports of wheat could increase sufficiently to cause major adjustments in world markets (fig. 2).

Exports of other grains are relatively less important (table 12).

Table 12.--Soviet Union exports of principal grains other than wheat, 1955-58 1/

Commodity	1955	1956	1957	1958	1959
		(1,000 Metric tons)			
Rye	780.1	519.4	440.6	461.0	548.9
Barley	565.0	785.4	1,214.0	278.3	121.6
Oats	79.5	164.4	223.5	261.1	131.4
Corn	307.4	294.7	84.6	220.5	154.9
Total	1,732.0	1,763.9	1,962.7	1,220.9	956.8

1/ Official Soviet sources.

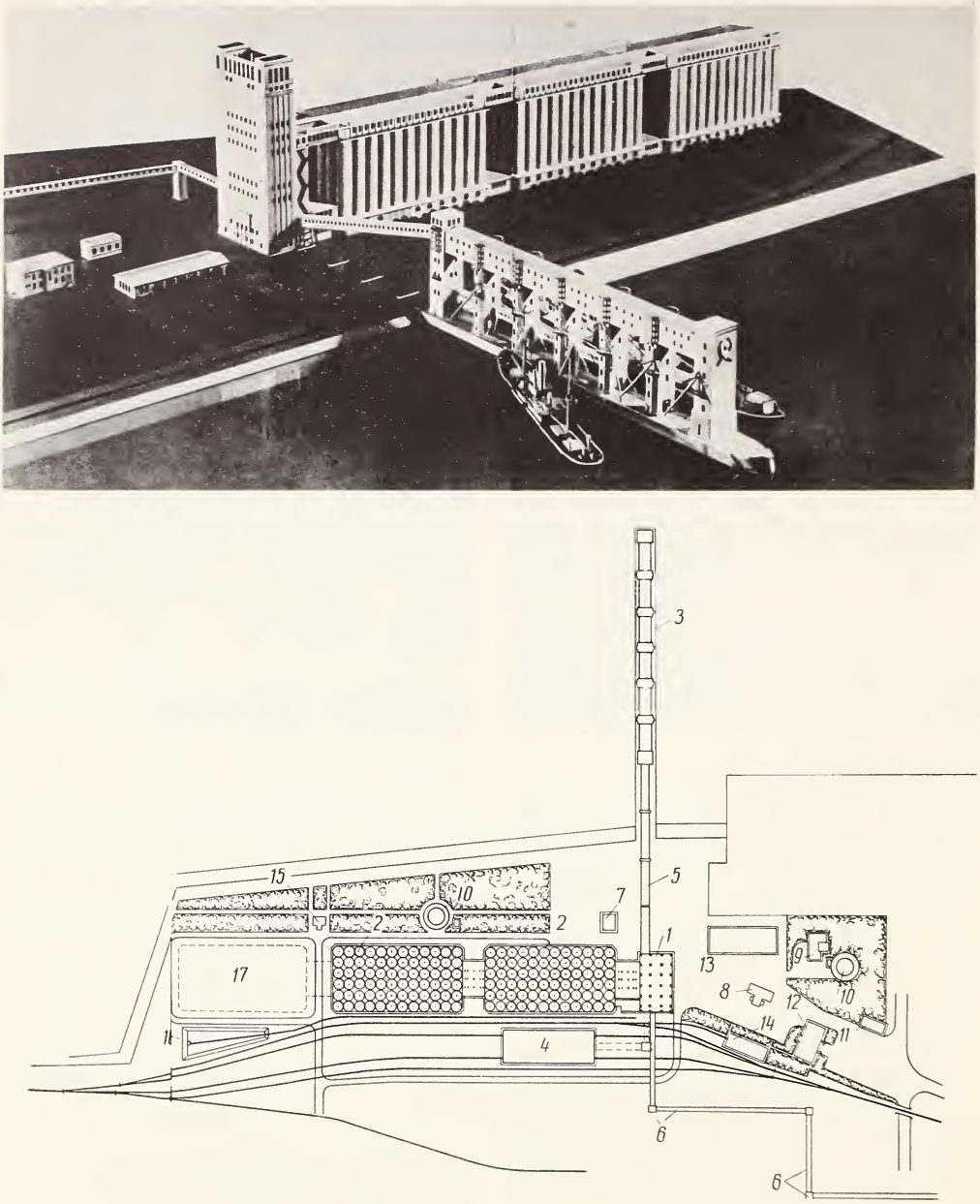

Figure 2.--Model (above) and layout of port elevator under construction at Odessa. (1) Work house. (2) Silo blocks. (3) Jetty. (4) Installation for receiving grain from rail cars (wagons). (5) Conveyor for loading and unloading ships. (6) Conveyor for grain delivery to mill. (7) Refuse section. (8) Truck (lorry) scales. (9) Pumping station and fire department. (10) Water tank. (11) Central control panel. (12) Office. (13) Shop, garage, etc. (14) Motor car depot. (15) Fuel storage. (16) Fuel bulk storage site. (17) Site for 3rd silo block.

Harvesting of small grains is well mechanized (table 13). Both the new self-propelled combines and the older tractor drawn units are similar to our equipment. In fact, they appear to be patterned after ours. In the handling of grain on the farm, however, they use much more hand labor. The major differences in their harvesting methods appear to be that they tend to cut and windrow more of their winter wheat before combining, cut the grain lower, and use more straw for feed and paper. They also use horses and wagons to haul much of the grain back to the farm although trucks are used to haul it to the elevator. The small grains are piled on the ground before they are cleaned by women workers and finally taken to the elevator or to farm storage.

Most farm machinery seemed to be left out-of-doors; we saw few machinery buildings. Likewise, there appeared to be little planning of farm building location to ease the work or allow shifting from one job to another (fig. 3).

Corn cultural practices seemed to vary from our own primarily in that the Soviets check-row their corn. Corn harvesting was said to be mechanized. We were told that about 98 percent of the corn for grain acreage was planted with their own hybrid corn seed.

About one-half of the Soviet sugar beet acreage is said to be planted with monogerm seed.

The Soviets have insect problems which apparently are somewhat less important than in our country, if we exclude the problem of a new insect of the genus Euryaster. This insect came into their country from Iran. It sucks juice from the wheat kernel when it is in the milk stage and injects enzymes which help break down the starch, damaging the gluten and the baking quality of the wheat. A maximum of only 2 percent damage in the worst areas was reported, but it appeared that greater damage may actually have taken place.

There are indications that their seeding rate is somewhat higher than ours but that they use less fertilizer, herbicide,

Table 13.--Number of tractors, combines, and trucks on farms, Soviet Union, selected years 1/

Beginning of year	Tractors		Combines	Trucks
	Number	Drawbar power		
	Thousands	Million horsepower	Thousands	Thousands
1929	27	--	2	1
1933	148	--	14	14
1941	531	10.3	182	228
1951	595	14.0	211	283
1954	744	18.6	318	424
1957	870	23.1	375	631
1958	924	24.5	483	660
1959	1001	26.3	502	700
1960	1036	28.5	492	729

1/ Data from official sources.

Figure 3.--New self-propelled combines at a State Farm near Kustanay.

and insecticide than we do. In their efforts to increase yields they expect to increase their use of fertilizer, insecticides and herbicides but appear to be placing even heavier emphasis on the use of better producing varieties. We visited a number of plant breeding research institutes which appear to be doing a good job.

In Moscow we were told that the official estimates of grain production are obtained both from the farm and the assembling elevators. Reports are made every 10 days during the harvest period. For wheat, these reports are based upon actual weight if moisture content of wheat is lower than 15.5 percent; if higher, it is reported on the basis of 15.5 percent moisture. During our farm visits we heard the same statement except that the break point for moisture content appeared to vary by area from 16.0 - 14.0 percent.

Stalin Kolkhozy

This collective farm is located in the Ukraine, near Oddessa. In 1960 it had 10,872 acres of crops--2,718 acres of winter wheat, 741 acres of corn for grain, 2,224 acres of corn for silage, 247 acres of oats, 1,248 acres of barley plus minor crops, and hay and pasture. The average wheat yield was said to be 42 bushels per acre and corn for grain 89 bushels per acre.

The farm is run by a farm chairman and three brigadiers. One of the brigadiers was in charge of crop production, another livestock production, and the third was responsible for economic - administration including building and machinery. We visited the home of the livestock brigadier, which, although small, was well furnished. It was obvious that space was at a premium for this young family since a bed occupied one part of the

Figure 4.--(Above) Grain harvesting at collective farm near Krasnodar. (Below) Grain wagons and temporary feed storage.

living room. The brigadier's wife also worked on the farm. She was in charge of swine production.

The farm gross income was divided in the following manner:

Item	Percent of total
Workers	60
Machinery, repairs, etc. 1/	20
Schools, hospitals, and pensions	10
State	10
Total	100

1/ Indivisible fund.

The average worker received about 775 rubles per month with worker incomes ranging from 400 to 2,000 rubles per month.

Red Star Kolkhozy

This collective farm is located in the Northern Caucasus near Krasnodar. In 1960 it had 31,628 acres of crops--7,413 winter wheat, 3,706 corn for grain, 3,212 corn for silage, 3,954 sugar beets, 1,977 sunflower, 618 fruit, other minor crops and hay and pasture. We were told that the average yields are 55 bushels for wheat and 67 bushels for corn per acre.

The population of this collective farm was 7,000, including 3,000 full time workers. The annual gross income was divided in the following manner:

Item	Percent of total
Workers	50
Buildings, machine repairs, etc. 1/	30
Other operating costs	5
Culture and pensions	5
State	10
Total	100

1/ Indivisible fund.

The average income of the workers was 700 to 800 rubles per month. Again we visited the home of one of the workers. It was being enlarged at the time of our visit. The two-room home was well furnished (they do not count the kitchen as a room). The one-quarter hectare garden plot contained a good crop of many kinds of vegetables, grapes and other fruits.

Zatobolsky Sovkhozy

This State farm is located in Kasakhstan, near Kustanai. In 1960 it had 96,369 acres with 54,362 acres in cultivation. The farm had 43,242 acres in spring wheat and a little durum, and 11,120 acres in feed grains (including corn for silage). The average wheat yield was said to be 20 bushels per acre. Our group estimated the crop we saw in the "heading stage" to yield about 12 bushels per acre. The average precipitation in the area is 11.8 inches per year.

The farm managers indicated that 90 percent of the harvesting was done by the farm workers and 10 percent by harvest workers. They said that the monthly wages of their workers approximate the income of the collective farmers. They also indicated that they recognized the possibility of wind erosion in their area but have not experienced any as yet. They said that they followed crop rotation and fallow practices and were trying to learn from our experience with wind erosion.

QUALITY EVALUATION

The All-Union Scientific Research Institute of Grain and Grain Products has the basic responsibility for grain quality evaluation, research, standardization research and the development of new and revised standards, grain inspection, grain breeding, and milling equipment improvement research in the Soviet Union. The wheat quality evaluation laboratory of the Institute is well equipped with mechanical equipment such as the Buhler experimental mill, Farinograph, Alveograph, Extensograph, and Amylograph, as well as a device

that might be described as a micro-extensograph devised by Dr. Karacsonyi of Budapest. Equipment of foreign manufacture is rarely seen in the Soviet Union. The above-mentioned items, therefore, were a notable exception to this rule. In view of the importance of this Institute the following information on quality evaluations is based upon the tests and work conducted and coordinated by the Institute.

Bread - Baking Tests. -- Bread - baking tests are usually made by a "pup" loaf straight-dough method using 100 g. flour, 2.5 g. compressed yeast, 3.0 g. sugar, and 1.0 g. salt. The mixing time is 1.5 to 3.0 minutes and is determined subjectively by the behavior of the dough. The fermentation time is from 2.5 to 3.0 hours at 27° - 28° C. during which time the dough is punched twice. The loaves are molded by hand. Proofing time is from 30 to 60 minutes and the doughs are proofed to a constant height, then baked at 230° C. for 20-25 minutes. Volume of the loaf is measured by displacement with millet seed. After cooling the loaf is cut and judged for grain, texture, and crumb color. Loaf volume is considered to be the most important index of quality.

Klyeikovina.--Protein content of wheat, as such, is rarely determined in the Soviet Union, but the "klyeikovina" test is used in its place. Klyeikovina is similar to wet gluten, but, unlike the wet gluten test sometimes used in the U. S. and elsewhere, the determination is made on wheat (whole wheat meal) rather than flour. The klyeikovina content of wheat is usually about 2.3 times the protein content, while the wet gluten content of flour is usually about 3.0 times the protein content. Klyeikovina is determined as follows:

> About 30 grams of wheat are ground with a small, high-speed grinder similar to the Moulinex mill. A 25-gram portion of the ground wheat is mixed with 14 ml. of water with a pestle in a mortar to form a dough. The dough is rolled by hand into a ball which is allowed to stand for 15 minutes. The dough is then washed by hand in a pan of water or with a mechanical washing device until most of the bran and starch are removed and is then kneaded by hand until the excess water is removed. It is then weighted. Klyeikovina is then determined by the formula

$$\frac{\text{Weight} \times 100}{25} = \% \text{ Klyeikovina}$$

Where the weight represents the weight of final dough in grams. The only reason given for the widespread use of the klyeikovina determination instead of the kjeldahl protein determination is that it is simpler and more rapid and therefore practical of application in the inspection of wheat. Klyeikovina is determined on all wheat inspected and is shown as supplementary information on inspection certificates. It is shown on request on export certificates. The wisdom of using such a test seems questionable because of the probable lack of repeatability of results.

Gluten Quality.--A unique simple test is being used experimentally at the Institute to measure gluten quality. A 2.5-gram portion of wet gluten from the klyeikovina test is formed into a small ring which is suspended from a hook in a cylinder of water at 30° C. after attaching a 2-gram weight to the bottom of the ring. The rate of stretching of the dough is determined by measuring the length to which it has stretched in one hour or less. A rate of 0.4 mm. per minute is considered normal for strong gluten. Weak gluten will stretch much more rapidly.

Sedimentation Test.--Work at the Institute with the sedimentation test has failed to show any significant correlation between sedimentation value and bread loaf volume. This is probably due in part to the fact that in the bread-baking test proofing is carried to a constant height rather than for a constant time, thus minimizing differences in loaf volume. Strangely enough, no information was

available on what correlations were obtained between loaf volume and protein content, klyeikovina content, farinograph values, or alveograph values.

Vitreousness.--The factor "vitreousness" is used in the USSR wheat standards in a similar manner as the factors "dark, hard, and vitreous kernels" or "hard kernels" are used in the U. S. wheat standards. Vitreousness is expressed as the percentage of vitreous kernels and a kernel judged to be "half vitreous" contributes half as much toward this percentage as a "vitreous" kernel. The determination is made by selecting 100 kernels at random and placing them in the small openings on a plastic disk about 3 inches in diameter. This disk is then placed over a light. The kernels that appear translucent are considered vitreous and those that are opaque are considered not vitreous. Most kernels fall clearly into one or the other of these classifications. Doubtful kernels are cut in two pieces crosswise and from the appearance of the cross sections are judged to be vitreous, not vitreous, or "half vitreous." This method is, on the average, more time consuming than ours; with our method the determination is usually made at a glance. The USSR method is also more subject to sampling error than ours since they use only 100 kernels. A considerably more accurate appraisal of individual kernels and possibly of overall vitreousness is probably attained by the USSR method.

Moisture.--The basic method for determining the moisture content of grain consists in grinding the sample with a small high-speed, Russian-made grinder of the Moulinex type, weighing portions of the gound material, and then drying them at 130° C. for 40 minutes. A two-stage method is used for high-moisture grain. This method would probably give results about 0.2 percent lower than the U. S. official method for the small grains and somewhat higher than the U. S. method for corn. For most inspection purposes a conductivity-type electric moisture meter somewhat similar to the British-made Marconi meter is used. A 5-gram portion of the wheat is pressed to constant pressure in a small cylinder by means of a screw press. The meter is calibrated against the basic oven method. All inspectors are equipped to make oven moisture tests and do make them in cases of dispute or doubt or when the moisture content is below 12 percent, since the accuracy of the meter is low on dry grain. At one place a moisture meter which was almost an exact copy of the Weston ("Tag") meter was seen. This meter was said to be more accurate than the type in common use but was subject to a maximum error of 1.5 percent moisture in wheat (about the same in this respect as our Weston meter).

GRAIN INSPECTION

The inspection of wheat in the USSR, based largely on our observation of procedures but partly on information supplied to our delegation, is carried on in the following manner:

1. Wheat is first "inspected" in the field just prior to harvest on State and collective farms. This is done by agronomists to determine purity of type and variety.

2. Each truckload of wheat before it leaves the farm is inspected for type only and weighed. A certificate is issued showing the type, weight, and the point of origin. This certificate accompanies the truckload to the elevator.

3. In each Oblast (political subdivision of a Republic) there is one local grain inspector for each elevator or other collection point and one State grain inspector for several elevators or other collection points. The State inspector checks and supervises the work of the local inspector.

Each truckload of wheat received from the farm is sampled and inspected for moisture content and insect infestation. The remaining samples representing each type of wheat from each farm are composited and the 24-hour composite sample is then analyzed for all grading factors and the grade established.

4. At export elevators each car or barge of wheat received from an inland elevator is accompanied by an inspection certificate issued by the inland elevator inspector. The grade is checked by an inspector at the export elevator. When any disagreement occurs, the grade as determined by the export elevator inspector stands. Such disagreements are said to be rare.

5. Wheat for export is recleaned at the export elevator to not more than 1% foreign material (including dockage) and not more than 2% foreign material and "grain admixtures" combined (see explanation of standards for definitions). If necessary the wheat is dried to not more than 14.0% moisture. (Most export wheat is said to contain about 12.5% moisture). The wheat is sampled continuously at the spout during shiploading with a mechanical sampler (see sampling methods below) and the sample collected and graded each hour by a State grain inspector. The inspection includes the determination of "klyeikovina" (see explanation above) each hour, although this factor is shown on the export inspection certificate only when requested.

Sampling Methods

At collection point elevators where wheat is received from farms in trucks, each truckload is sampled by a woman using a probe connected to a suction line (fig. 5). The probe is inserted at uniform speed to the full depth of the truck near each of the four corners and in the middle. Grain is sucked into the probe from all levels at each of the five sampling points and is automatically delivered by means of the suction line into a divider in the laboratory where the sample from each truck (about 1 kg.) is cut down in one operation to 3 portions. One of these portions is used for examination for insect infestation, one for moisture determination, and one for the 24-hour composite (see explanation p. 26).

Grain in rail cars is sometimes sampled with the same type of vacuum probe but more commonly with a manual probe with a pointed conical container holding about a half pint on one end. This container is opened and closed by means of a control on the handle. The probe is inserted near each corner and the middle of the car and a sample taken from each of 3 levels at each of the 5 sampling points. The 15 portions thus obtained are composited and the composite sample is the official sample from the car. If any one of the 15 portions appears to be materially different from any other portion, the inspector is called to the car for a more detailed examination and sampling of it. This is said to happen rarely.

Barges are sampled in much the same way as cars. Each section of the barge is sampled in 4 places and all samples from the barge are normally composited. When grain is loaded into a ship for export, sampling is done at the spout, usually by means of a mechanical sampling device. This device (not seen since it was in an inaccessible location at the elevator we visited) is said to consist of a metal tube with many openings. This tube is mounted in a slightly tilted position with the openings on top, and oscillates continuously through the stream of grain. The grain entering the openings flows out of the lower end of the tube into a receptacle. This mechanical sampler collects about 100 grams of grain for each ton loaded. The sample is collected and graded (including the klyeikovina determination) once each hour during loading.

Figure 5.--Sampling a load of wheat with a suction probe near Krasnodar.

Inspection Analysis

Wheat samples drawn for inspection are analyzed (fig. 6) in the following manner:

1. One kg. of the sample is shaken mechanically on a 1.5 mm. round-hole sieve. The material passing through the sieve is examined for live insects and returned to the bulk of the sample.

2. The entire inspection sample is mixed with a divider (Boerner type).

3. Test weight in terms of grams per liter is determined by weighing one liter of wheat in a metal cylinder.

4. A 50 g. and a 5 g. portion are obtained by means of the divider.

5. Moisture content is determined on the 5 g. portion by means of an electric meter similar to the Marconi meter. (See description p. 24). If the moisture is less than 12.0% it is determined by the oven method previously described.

6. The 50 g. portion is sieved simultaneously with a 1.7 x 20 mm. and a 0.5 mm. round-hole sieve. The material through the 1.7 x 20 mm. sieve is weighted and the percentage determined. This is recorded as a separate grading factor. The material through the 0.5 mm. sieve is recorded as "mineral matter" (dirt, sand, etc.) on the work sheet and is part of the foreign material.

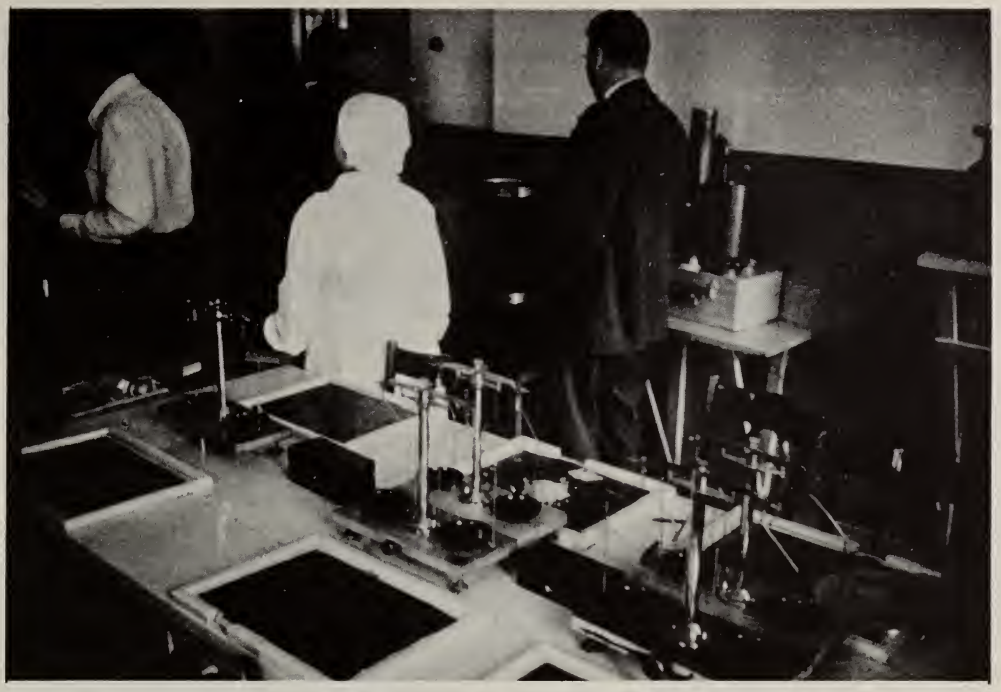

Figure 6.--Typical flour mill laboratory.

7. The material remaining on the 1.7 x 20 mm. sieve is handpicked for the various types of foreign material and "grain admixtures" defined in the standards. (See footnotes 1 and 2 in table of wheat class specifications p. 29). Handpicking is done on glass over a white background.

8. Vitreousness is determined on 100 kernels. (See p. 24).

9. Klyeikovina is determined (see p. 23).

10. The sample is re-examined for damage by the insect Euryaster (See p. 19). This is a special type of damage not specifically mentioned in the standards. Not more than 2.0% of this type of damage is permitted in export wheat of any grade.

GRAIN STANDARDS

The All-Union Scientific Research Institute of Grain and Allied Products is responsible for standardization research and for recommending new or revised grain standards. Recommendations go to the State Committee for Grain and Grain Products for consideration and from there to the State Standards Committee for final approval and promulgation. The recommendations made by the Institute are usually adopted with little or no change. USSR standards are in effect for wheat, corn, barley, rye, oats, rice, buckwheat, millet, beans, peas, and lentils.

A book containing all the details of these standards was presented to the team by the State Committee for Grain and Grain Products at the final conference we attended.

Under the Soviet wheat standards there are 5 types of wheat corresponding roughly with our classes. Most of the types have 2 or more subtypes corresponding roughly with our subclasses, and each subtype (or type where no subtypes occur) has 5 classes analogous to our grades.

For the purpose of these standards wheat is defined as any grain consisting of not less than 85% of wheat.

The types, subtypes, and classes of wheat are as follows:

Type I. Red Spring. Shall contain not more than 10% of other types but not more than 5% of durum wheat.

Subtype 1. Dark Red Spring Vitreous. Shall be not less than 75% vitreous.

Subtype 2. Red Spring. Shall be not less than 60% or more than 74% vitrous.

Subtype 3. Light Red Spring. Shall be not less than 40% or more than 59% vitreous.

Subtype 4. Yellow-Red Spring. Shall be not less than 40% vitreous. (This subtype differs from subtype 3 only in respect to color and in not having a top limit for vitreousness.)

Subtype 5. Yellow Spring. Shall be be less than 40% vitreous.

Type II. Durum. Shall contain not more than 10% of other types.

Subtype 1. Dark Amber Durum. Shall have a uniform dark amber color.

Subtype 2. Light Amber Durum. Shall have a uniform light amber color. (Mixtures of subtypes 1 and 2 are designated "Mixtures of Subtypes".)

Type III. White Spring. Shall contain not more than 10% of other types but not more than 5% of durum wheat.

Subtype 1. White Spring Vitreous. Shall be not less than 60% vitreous.

Subtype 2. White Spring. Shall be less than 60% vitreous.

Type IV. Red Winter. Shall contain not more than 10% of other types but not more than 5% of durum wheat.

Subtype 1. Dark Red Winter Vitreous. Shall be not less than 75% vitreous.

Subtype 2. Red Winter. Shall be not less than 60% or more than 74% vitreous.

Subtype 3. Light Red Winter. Shall be not less than 40% or more than 59% vitreous.

Subtype 4. Yellow-Red Winter. Shall be not less than 40% vitreous. (This subtype differs from Subtype 3 only in respect to color and in not having a top limit for vitreousness.)

Subtype 5. Yellow Winter. Shall be less than 40% vitreous.

Type V. White Winter. Shall contain not more than 10% of other types but not more than 5 percent of durum wheat. (No subtypes.)

All subtypes (and in the case of Type V the type itself) are divided into 5 classes, the specifications of which are as follows:

Class	Minimum limits		Maximum limits in percent						
	Test weight		Foreign material 1/			Grain admixtures 2/		Total material through 1.7 x 20 mm sieve	Moisture 3/
	Grams per liter	Kilograms per hectoliter	Total	Part of total: Cockle	Part of total: Other harmful seeds	In spring wheat	In winter wheat		
1	785	78	1	0.5	0.2	2	3	5	15.5
2	765	77	2	0.5	0.2	2	4	5	15.5
3	745	75	3	0.5	0.2	4	5	7	15.5
4	725	73	3	0.5	0.2	4	6	8	16.0
5	No minimum limit		4	0.5	0.2	6	7	10	16.0

1/ Foreign material includes all material passing through a 0.5 mm. roundhole sieve; all seeds except wheat, rye, and barley; rotten, moldy, or charred wheat, rye, or barley; pieces of stems, ears, chaff, etc.; and all harmful material.

2/ Grain admixtures include broken or insect-damaged kernels with less than 1/2 of kernel left; sprouted kernels; frost-damaged kernels; heat-damaged kernels; distinctly underdeveloped kernels; green kernels; crushed kernels; kernels of rye and barley not included in foreign material.

3/ Wheat for export must never contain more than 14.0% moisture.

If wheat is of inferior quality because it is sour, musty, smutty, weevily, ergoty, etc., the inspection certificate will state "Wheat does not meet standards because (reason given)."

For export purposes code numbers are used to designate the type, subtype, and class of wheat. For example 4-3-1 means wheat of Type IV (Red Winter), Subtype 3 (Light Red Winter), and Class 1.

A revision of the USSR wheat standards is under consideration for adoption in 1961. The revision, if adopted, will provide a standard for "Strong Wheat" intended primarily for export purposes, and perhaps also for a dockage system.

GRAIN ELEVATORS

Soviet statistics indicate that the off-farm grain storage capacity in the Soviet Union was 80.1 million metric tons (table 14). The goal for 1965 is to increase this capacity to 105.3 million metric tons, with most of the increased storage capacity to be located in the Kasakhstan and the Ural (New Land) Regions.

Grain storage facilities in the Soviet Union apparently are divided into three general types or classifications, namely: Collection point elevators; mill elevators; and trans-shipment elevator (subterminal, terminal, and port.)

Collection point elevators are preferably located along railroads or rivers. Grain is received directly from farms generally by road trucks (lorries). Trucks are unloaded mechanically into underground dump pits holding from 25 to 50 tons each that are located in a building separate from the elevator. Grain moves from the pit by underground conveyors to the working house. The grain is cleaned

Table 14.--Growth in storage capacity, selected years 1913-65

Year	USSR	Kasakhstan	Ural	Other areas
		(Million Metric Tons)		
1913	4.1	---	---	4.1
1940	35.7	1.3	7.2	27.2
1953	62.5	2.8	13.4	46.3
1959	80.1	2.8	20.2	57.1
1965	105.3	17.8	26.3	61.0

and dried if foreign material and moisture content are excessive. Grain is generally shipped out as soon as possible to mills or to transfer elevators.

Mill combine elevators are constructed in connection with flour mills. Grain is received from collection point and transfer elevators and in some cases directly from farms. The elevators provide facilities for the necessary cleaning, drying, and storage of grain moving to the mill.

Trans-shipment elevators usually serve as points of accumulation and storage of large quantities of grain sometimes for as long as one year. These elevators are located on railroads or rivers or at seasports for transferring grain from truck to rail, rail to water, and back again. They are equipped to clean and dry grain for storage, for export, or for transfer to mills. They also may be equipped to operate as a collection point elevator for local production.

Soviet officials estimated that collection point elevators provided 70 percent of the total grain storage capacity available in 1960; milling combine elevators 15 percent; and transfer elevators 15 percent.

In the New Lands area flat storage is considered a temporary measure for handling surplus grain. Such storages are often used there because they can be constructed more quickly and cheaply than silos. In the Caucasus it seemed that flat storages are being used as permanent installations such as those used at the Milling Combine in Krasnodar. There the operation included receiving, cleaning, drying, aeration, and storing of grain for use in nearby mills.

Table 15 lists the grain storage facilities visited which included some of each of the three general types. The total capacities of the storages visited ranged from 24,000 tons at Milling Combine No. 3 at Moscow, up to 150,000 tons at the port elevators. Individual storage units are compared as to type, capacity, and size. Comparative capacities of the vertical bucket elevators are given as an indication of the rates at which grain can be moved within the elevator; also, the comparative capacities of the dryers in a number of facilities visited.

Some elevator operators reported handling 4 to 5 times their storage capacity per year, others 8 to 10 times, and one milling combine in Moscow reported 17 turnovers per year.

Apparently all elevators in the Soviet Union are equipped to clean and dry a much larger proportion of their receipts than comparable elevators in the United States.

Milling Combine No. 4

The mechanized elevator visited at Milling Combine No. 4 in Moscow was of particular interest. The movement of grain into, within, and out of the elevator is directed by a single person at the desk or console in the control room of the combine. Reportedly, only 4 employees are required to operate the entire elevator,

Table 15.--Grain storage facilities visited

Name and location	Type	Total capacity	Storage unit					Bucket elevator		Dryer	
			Type	No.	Capacity per unit	Diameter or width	Height	No.	Total capacity per hour	No.	Capacity per hour
Kirov Milling Combine, Leningrad	Mill	1/108,000 tons (4,000,000 bu.)	Silo	135	800 tons (29,400 bu.)	2/	2/	4	1,400 tons (51,300 bu.)		2/
Kustanay Elevator, Kustanay	Trans-shipment	50,000 tons (1,835,000 bu.)	Silo	84	600 tons (22,000 bu.)	6M (20')	30M (100')	4	400 - 700 tons (Est.)	3	96 tons (3,500 bu.)
		100,000 tons (3,670,000 bu.)	Flat	33	3,000 tons (110,000 bu.)	20 M x 60 M x 3 M (65.5' x 197' x 10')			(14,400 - 25,600 bu.)		
Aman-Karagai Elevator, Kustanay	Collection point	22,000 tons (807.000 bu.)	Silo	80	280 tons (10,000 bu.)	3200 MM x 3200 MM x 30 M (10.7' x 10.7' x 100')		2	400 - 700 tons (Est.)		2/
		30,000 tons (1,100,000 bu.)	Flat	10	3,000 tons (110,000 bu.)	20 M x 60 M x 3 M (65.6' x 197' x 10'			(14,400 - 25,600 bu.)		
Milling Combine No. 1, Kiev	Mill	32,000 tons (1,168,000 bu.)	Silo	48	650 tons (23,800 bu.)	6M (20')	30M (100')	2/	2/	1	16 tons(Est) (585 bu.)
Odessa Seaport Elevator, Odessa 3/	Port	150,000 tons (5,500,000 bu.)	Silo	216	700 tons (25,000 bu.)	6M (20')	30M (100')	5	1,750 tons (54,000 bu.)	1	16 tons (585 bu.)
Novorossisk Seaport Elevator, Novorossisk	Port	150,000 tons (5,500,000 bu.)	Silo	100	800 tons (29,400 bu.)	2/		5	1,750 tons (54,400 bu.)	2	32 tons (1,170 bu.)
			Silo	New: 2/ Old:	2/	2/					
Krasnodar Milling Combine, Krasnodar	Mill	50,000 tons (1,835,000 bu.)	Flat	25	2,000 tons (73,400 bu.)	20 M x 60 M x 3 M (65.5' x 197' x 7+')		2/	2/		4/
Milling Combine No. 3, Moscow	Mill	24,000 tons (885,000 bu.)	Silo	36	650 tons (23,800 bu.)	6M (20')	30M (100')	4	400 tons (14,400 bu.)	1	16 tons (585 bu.)
Tsyuryupi Milling Combine, Moscow	Mill	40,000 tons (1,470,000 bu.)	Silo	2/	750 tons (27,500 bu.)	7M (23')	24M (80')	2	200 tons (7,200 bu.)	2	24 tons (880 bu.)
			Silo	2/	1,500 tons (55,000 bu.)	11.5M (38')	24M (80')	3	750 tons (27,000 bu.)		
Milling Combine No. 4, Moscow	Mill	72,000 tons (1,470,000 bu.)	Silo	120	600 tons (22,000 bu.)	6M (20')	30M (100')	4	1,400 tons (51,300 bu.)	2	40 tons (1,460 bu.)

1/ Metric ton = 2204.6 lb. = 36.7 bushels at 60 lbs. per bushel. M = meter = 3.3 feet. Mm = millimeter = 0.0033 feet.
2/ Information not obtained.
3/ Under construction.
4/ No tower (column dryers, aeration fans plus supplemental heat used to dry grain with moisture content as high as 17 to 18 percent.

excluding the chief mill and elevator engineer. The elevator engineer is a woman and she controls the entire elevator operation of 182 electric motors from a central control room. Soviet officials indicated that the main reasons for automatic control and operation of grain elevators are to save labor and to provide more fool-proof and efficient operation than that provided by manual control.

Of special interest in this elevator were the devices for remote-controlling the flow of grain throught the elevator. Pneumatic gate valves are used under the silo hoppers (fig. 7) to control the flow of grain onto the conveyor belts. The volume of grain flowing is determined in the control room by ammeter readings of the load on the conveyor motor. An adjustable stop on the gate valve shaft must be set manually to regulate the volume to be conveyed. It appeared that the system would be improved if the adjustable stop could be remotely controlled from the control room.

Electrically operated butterfly valves are used in the discharge spouts to direct the flow of grain (fig. 8). Lights in the control room signal the position of these valves.

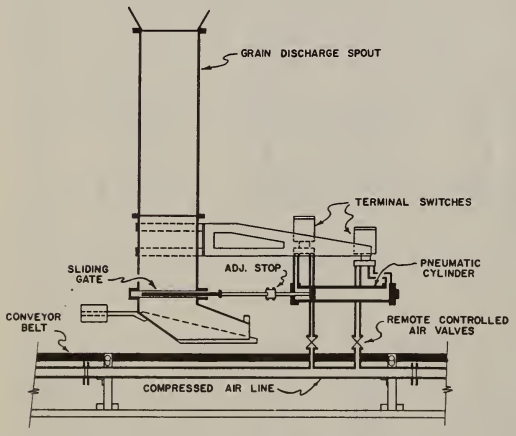

Figure 7.--Pneumatically operated sliding gate under hopper bottom silos for remote control of flow of grain onto belt conveyors.

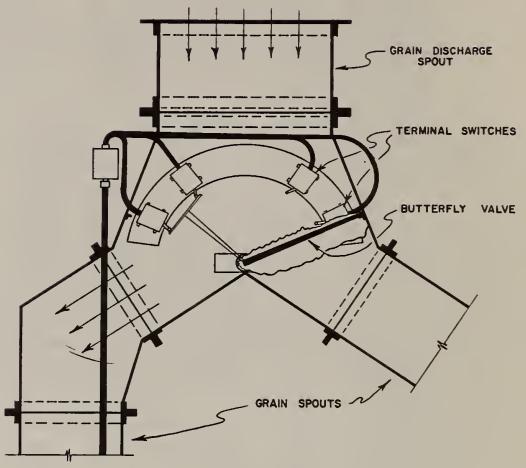

Figure 8.--Electrically operated butterfly valves in discharge spouts for remote control of direction of grain flow.

Electrically driven rotating distributor spouts direct the grain to the various silos or to other desired positions. While rotating, the distributor touches intermediate and terminal switches which send signals to the control panel and stop the distributor at the preselected location.

Diaphragm-type indications are used to signal the control room as the bin is becoming filled and to stop operations when the bin is full.

Construction

All of the silos observed were of reinforced concrete construction. There was no evidence of steel silos or storages, or of plans for them. The older silos were either round or rectangular but

the newer ones were round and of monolithic, slip-form construction. These newer silos are 6 meters (approx. 20') in diameter and 30 meters (approx. 100') high which apparently is the standard size that is being used. This silo, with a volume of 31,400 cubic feet, should hold some 25,000 bushels of wheat or approximately 685 metric tons. The Soviets reported capacities for this silo ranging from 600 to 700 tons which is a reasonable range when different grains and degree of loading are considered.

Although the concrete construction seemed substantial and adequate, the construction work was crudely done in a number of the elevators we visited. This was also true of the metal work done in connection with the installation of equipment, spouting, and machinery. Some concrete elevators including the machinery and equipment that appeared to have been used for a number of years actually had been in service for only one or two years.

The layout, and a model, of the port elevator that was under construction at Odessa during our visit are shown in figure 2. Two banks of silos are scheduled to be completed in 1960 and the third in 1961. Technical data supplied for this type and size of port elevator indicate that the following operations can be performed in 24 hours: Receive 8,300 tons of wheat (304,000 bushels) from rail cars and 2,000 tons (73,400 bushels) from ships; load 11,000 (403,000 bushels) into ships; clean 6,900 tons (253,000 bushels); dry 385 to 800 tons (14,000 to 29,000 bushels); turn 1,400 tons (51,000 bushels); and deliver 600 tons (22,000 bushels) to the flour mill. Reportedly, the only elevator in the USSR that is larger is the river port elevator at Omsk with a total capacity of 162,000 tons or nearly 6,000,000 bushels of wheat.

Figure 9 shows a layout, and model, of an elevator with a combination of silos and flat (mechanized) storages. This elevator is designed for receiving large quantities of grain from farms, for shipping it on to mills or port elevators, and for storing quantities until shipped.

Soviet officials furnished some information regarding a prefabricated concrete elevator that, reportedly, is commonly used in the USSR. The prefabricated sections are 3.2 meters (10.5') square and 1 meter (3.3') high. A plastic is used to seal the joints between the sections. Capacities of these elevators seldom exceed 7,300 tons (267,900 bushels of wheat).

Handling Equipment

Much of the handling equipment used in Soviet elevators is similar to that used in the United States but seems to be somewhat inferior in quality and workmanship.

Belt conveyors apparently are used for all horizontal conveying of grain; we did not see any screw or chain conveyors.

We saw dump pits designed for unloading road trucks but no semi-trailers, and there was no indication that semi's are used for hauling grain. Trucks were required to back into position at some dump pits and even to back up a ramp at one place.

Grain is unloaded from rail cars with power shovels. We were told that tests are underway on an experimental type of mechanical unloader that will tilt and shake the car the way ours do.

The truck scales observed were of a simple, non-registering, beam-type, and there was no indication that dial or printing types are being used.

There were, however, several innovations in handling equipment that were interesting and these are discussed below.

Elevating legs (bucket and endless belt) with capacities ranging from 100 up to 300 tons (3,670 to 12,800 bushels of wheat) per hour are used. Bucket (belt) speeds ranging from 3 meters up to 5.5 meters per second (594 to 1,080 feet per minute) were reported by operators of the elevators visited. However, an engineer

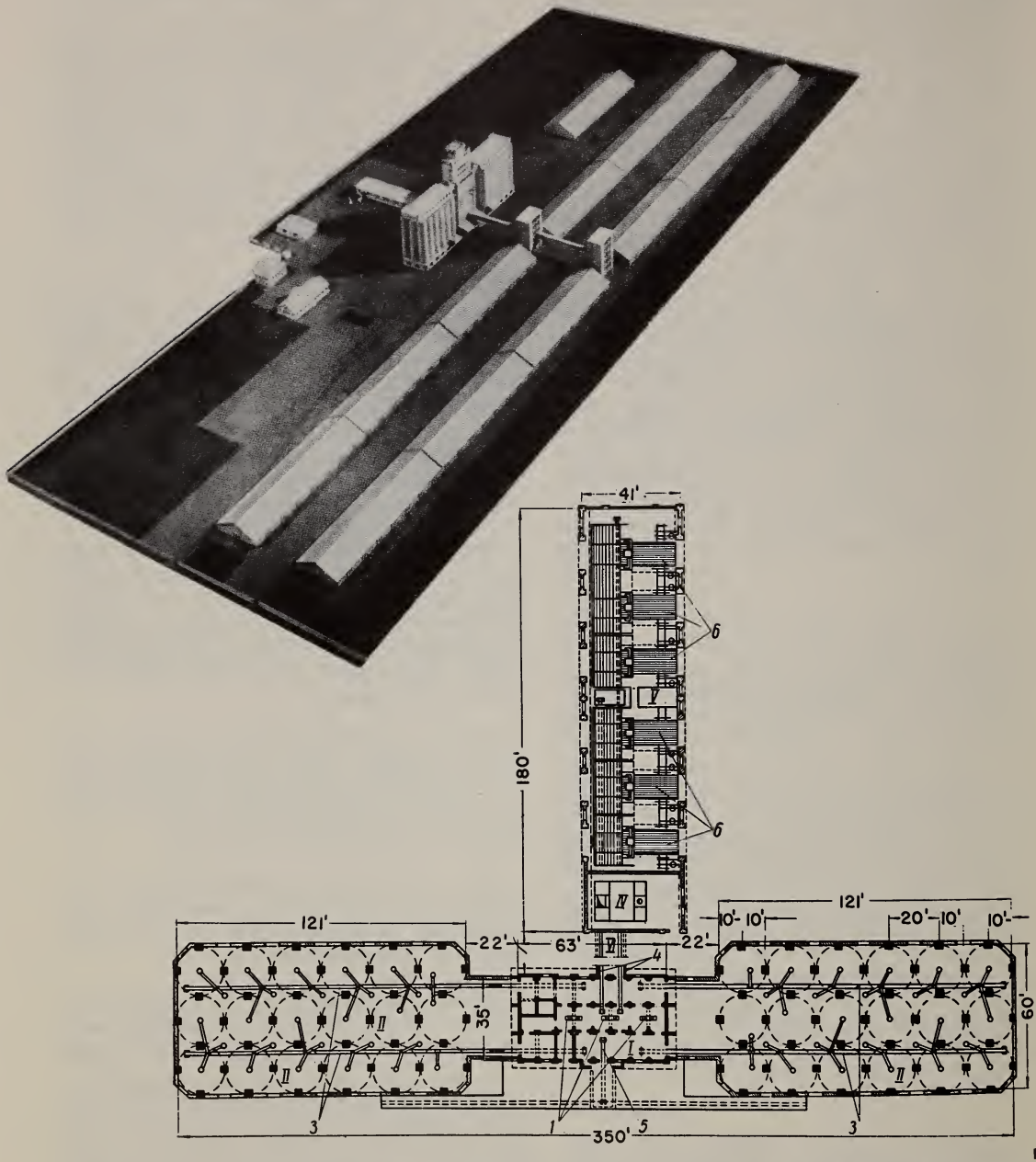

Figure 9.--Layout and model of elevator with combination of silos and mechanized (flat) storages. (1) Bucket elevators. (2) Lower belt conveyors. (3) Belt conveyors from truck (lorry) dump pit. (4) Belt conveyors from rail cars (wagons). (5) Truck dumps.

connected with the State Grain Committee stated that the maximum speed used in the Soviet Union was 4 meters per second (of 90 fpm) instead of 5.5 meters. This seemed to be a more logical bucket speed. Yet it was apparent that bucket speeds had been used that were excessive for conventional type buckets because a new type of bucket had been developed and was in use in several of the elevators visited. This "Phillipie" bucket (fig. 10) apparently was designed for more adequate filling and discharge at the higher bucket speeds. We had hoped to obtain plans and specifications for this bucket but were unable to do so. Phillipie buckets are to be installed in the new port elevator at Odessa; they are to operate at a speed of 3.8 meters per second (approx. 750 feet per minute). We concluded that this is to be the standard bucket type and speed to be used in newly constructed elevators.

A self-propelled grain loader (fig. 11) with a capacity of 100 tons (3,670 bushels of wheat) per hour was seen in the New Lands area and also at the Agricultural Exhibition in Moscow. The loader picks up grain from flat storages or grain piles on the ground and conveys it into a truck or other vehicle. It has a 16-horsepower engine and moves in reverse at speeds up to 1.75 kilometers (approx. 1 mile) per hour when picking up grain. We had no opportunity to see the loader in operation but it should work well.

Pneumatic Conveyors are currently used by the Soviets at port elevators to unload grain from ships. The conveyors are equipped with multistage turbo-pumps (centrifugal compressors) with as many as 6 stages. From the questions they asked us during our visit it was apparent that they are planning to expand the use of such conveyors. They were particularly interested in information available in the United States on the conveying of grain by fluidization. Research workers reported that they are now conveying 295 kilograms (649 pounds) of flour per kilogram (2.2 pounds) of air at a pressure of 1.5 atmospheres (45 inches hg).

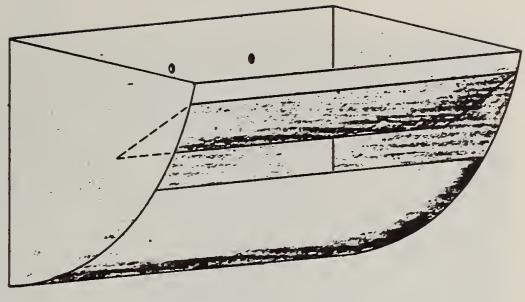

Figure 10.--"Phillipie" bucket designed to fill and empty satisfactorily at relatively high bucket (belt) speeds.

The pneumatic grain conveyors observed had suction tubes with diameters ranging from 100 to 115 millimeters (4 and 4.5 inches). The Soviets reported that air velocities within the delivery tubes ranged between 24 and 28 meters per second (4,700 to 5,500 fpm); that the turbo-pump operated against a pressure of approximately 4,000 millimeters (about 160 inches) of water, which is equivalent to 11.8 inches of mercury or 5.8 pounds per square inch; and that wheat capacities ranged from 20 to 40 tons (735 to 1,460 bushels) per hour.

Air capacities of the turbo-pumps were calculated from the information given us on tube diameters and air velocities within the tubes. These calculated capacities ranged from 60 to 70 cubic meters of air per minute (2,100 to 2,500 cfm). These capacities were considerably lower than those indicated by the Soviets which ranged up to 90 cubic meters of air per minute for units designed for large port elevators. Possibly either the tube size or tube velocities, or both, given us were in error.

Using our calculated air velocities, and the grain conveying capacities furnished by the Soviets, we estimated that the units might convey as much as 12 pounds of grain per pound of air delivered. Yet,

Figure 11.--Self-propelled grain loader.

by using the air capacities furnished by the Soviets it was estimated that the units were not conveying more than 4 pounds of grain per pound of air delivered. These are strictly estimates, however, based on information available and there is little basis for assuming that either estimate is accurate.

Other Methods and Equipment

Dust Control Systems in the elevators visited seemed to be well designed and well managed. For example, most of the horizontal belt conveyors, both above and below the silos, were enclosed with removable covers and connected to the dust collectors (fig. 12). In newly constructed elevators all conveyors are to be enclosed and under dust control. All the elevators we visited were very clean but as none were operating it was difficult to determine if this was due to the dust collectors or in part to a thorough clean-up by the elevator crew.

Grain Temperature Indicators were used in all of the elevators visited and apparently are standard equipment. Their thermocouple cables were similar to those used in the United States. One or two cables per bin with 5 to 6 thermocouple junctions per cable seemed to be standard. The cables are connected by extension lead wires to an indicating potentiometer

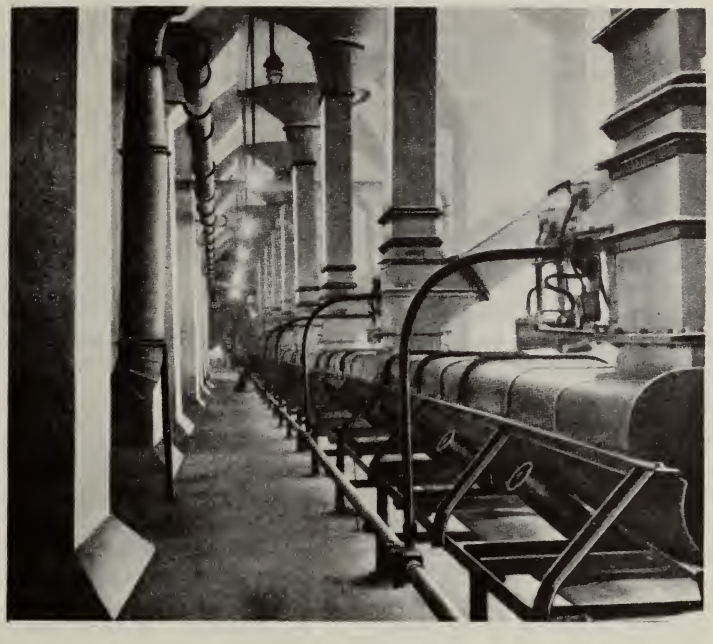

Figure 12.--Covered horizontal conveyor connected with the dust control system.

located in the office or control room of the elevator.

Conditioning Methods and Equipment

Cleaners.--Much of the grain is cleaned when it reaches the elevator and some is cleaned before it leaves the farm. Apparently it may be cleaned more than once because all the elevators visited, regardless of type, were equipped with cleaners. The capacity of the sieve-type separators ranges from 40 tons per hour to 100 tons per hour. Batteries of such separators are installed to obtain the desired cleaning rate. Other types of cleaners, such as the "Carter-disc" type, are provided for special jobs.

Turning.--Grain stored in silos is turned periodically to maintain its quality. If necessary, it is cleaned and fumigated during turning to control insects. Grain stored with moistures up to 14 percent is turned once a month, with moistures between 14 and 17 percent every 10 days, and with moistures above 17 percent it is turned daily until it can be dried.

Aeration.--No aeration systems were in use in grain silos in 1960. Most if not all of the mechanized (flat) storages were equipped with aeration systems and Soviet statistics showed 65,000 units in use in such storages in 1959. It is assumed that in many cases a number of units are installed in each storage. A grain temperature of 30° C. (96 °F.) is considered as dangerously high, and any grain as warm as that is cooled as soon as possible. A temperature of 10 ° C. (50 °F.) is considered optimum but grain may be cooled down to a low of 3°C. (37°F.).

Aeration systems are also used to dry grain with moistures as high as 18 percent. Portable supplemental heaters are sometimes used to heat the air a few degrees to speed up drying. In one type of system a perforated floor, built in sections (pallets), is placed over the existing storage floor to provide an air duct or plenum chamber for air to move into the stored grain. The airflow in this system was reported to be 40 cubic meters per hour per ton of grain (0.625 cfm per bushel of wheat).

In a second type of system air ducts or tunnels are built into the concrete floor. These ducts are equipped with

a plank cover with cracks along its two sides that allow air to pass from the duct into the stored grain (fig. 13). The reported airflow for this system was also about 40 cubic meters per hour per ton. Operators indicated that the storage was filled to a depth of some 3.5 meters (about 11.5 feet) but the total capacity given for the storage indicated a grain depth considerably less than 11.5 feet. The fans were reported to be operating against a static pressure of 180 millimeters of water (7.2 inches of water). This static pressure appeared to be excessive for the reported airflow rate even at a grain depth of 11.5 feet. This could be due, at least in part, to a high pressure drop or loss occurring in the system. For example, it was calculated that the velocity of the air entering the grain (from the cracks along the ducts) could be as high as 150 feet per minute. This is much higher than recommended in the United States, and could account for much of the high static pressure readings. Also, it was calculated that air velocities in some sections of the duct were excessive which also would cause an increase in static pressure.

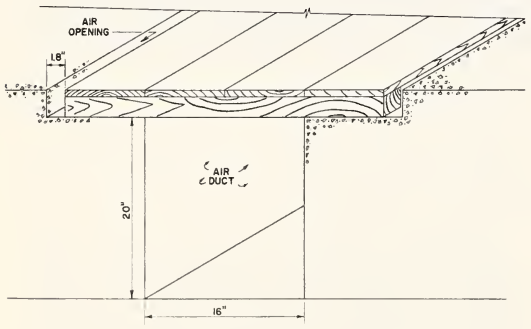

Figure 13.--Aeration duct system for mechanized (flat) storage. Tight wood cover over duct with air openings along the sides of cover.

A third type, the vertical tube aeration system, is illustrated in figure 14. The tubes are inserted in the grain after the storage is filled. The fan can be arranged to force air upward or downward through the grain. The following formula is used to determine the spacing of the tubes:

$$a = \sqrt{34\sqrt{\frac{Q}{H\,q\,s}}} \leq H$$

where,

a = distance between tubes, in meters (never more than H)

Q = quantity of air per tube, in cubic meters per hour (generally 1000 m^3)

H = depth of tubes, in meters

q = quantity of air, in cubic meters, per ton of stored grain

s = tons of grain per cubic meter

Drying Grain

Most, if not all, elevators in the USSR are equipped with dryers mainly of the stationary, continuous, column - or tower type. The drying capacity for each unit ranges up to 24 tons per hour, and possibly higher, for a moisture reduction of from 4 to 6 percent. From 50 to 100 cubic meters of air (1,750 to 2,100 cubic feet per minute) is supplied per ton of grain.

Dryers are used to the greatest extent in the New Lands area where up to 80 percent of all grain is dried during wet years. Reportedly, the moisture content of the grain in this area may be as high as 30 percent when harvested. Often supplemental portable dryers are needed to handle the large quantities of wet grain. Grain is dried to 14 or 15 percent if it is to be stored for any length of time.

There was considerable variation in the maximum drying air temperatures reported. These ranged from 90°C. (194 °F.) to 160 ° C. (320° F.) for the initial drying

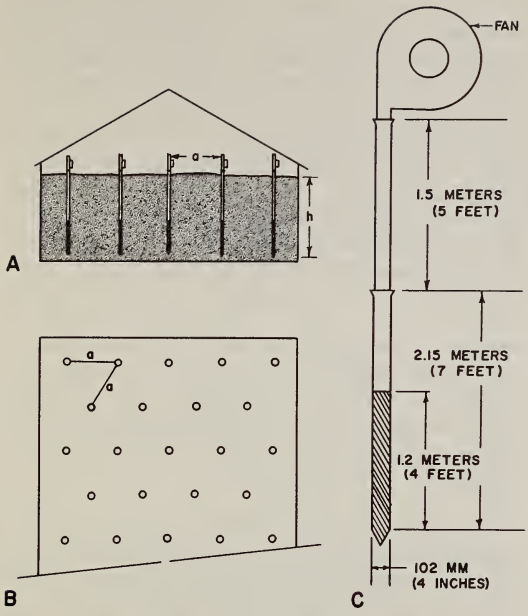

Figure 14.--Vertical tube type of aeration system for mechanized (flat) storage. (A) Tubes are inserted into stored grain. (B) Floor plan of storage showing spacing of tubes. (C) Lower 4 feet of bottom section of tube is perforated for air movement between aeration tube and grain.

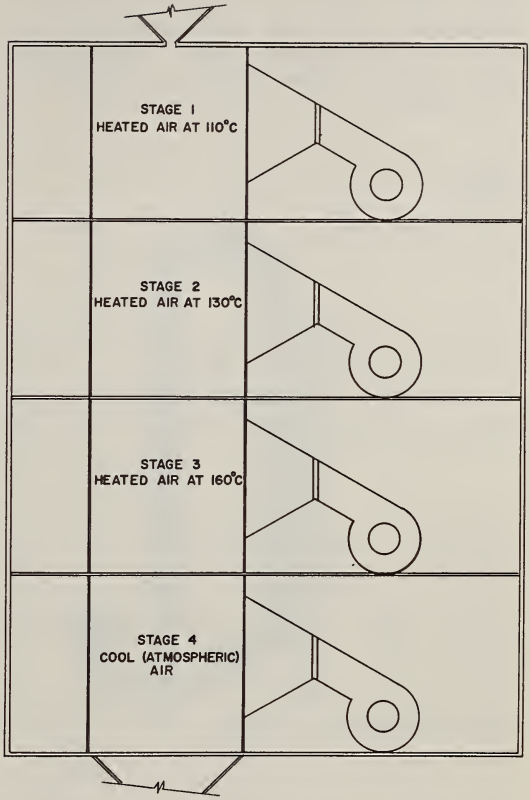

Figure 15.--A 3-stage tower grain dryer with reported drying air temperatures used in the various stages.

stage and from 110° C. (230° F.) to 160° C. (320° F.) for the final stage. All dryers observed had a cooling section. Most operators reported using the lowest air temperatures during the initial (wettest) drying stage but others reported the opposite. Temperatures of the grain coming from the dryer were reported to range from 50° C. to 60°C. (122° to 140°F.)

Two-stage and 3-stage drying seem to be commonly used. For example, figure 15 illustrates a 3-stage tower dryer and the reported drying air temperatures used at one elevator visited. Reportedly, the 2-stage dryer is more commonly used than the 3-stage.

Little information was received on the cost of drying grain but one estimate given was a total cost of 3 to 4 rubles per ton. It was also estimated that labor costs amounted to 40 percent and fuel costs from 20 to 25 percent of this total cost. Diesel oil was most commonly used for fuel but coal was used in at least one dryer visited. Some officials indicated that they are planning to change to gas in some areas.

The Soviets are doing considerable work to develop new and improved methods and equipment for drying grain. In one experimental type--the Belo-Russian dryer--the grain is dried in a semi-suspended state (fig. 16). In drying, the grain is alternately heated and cooled as it passes several times through the drying tube.

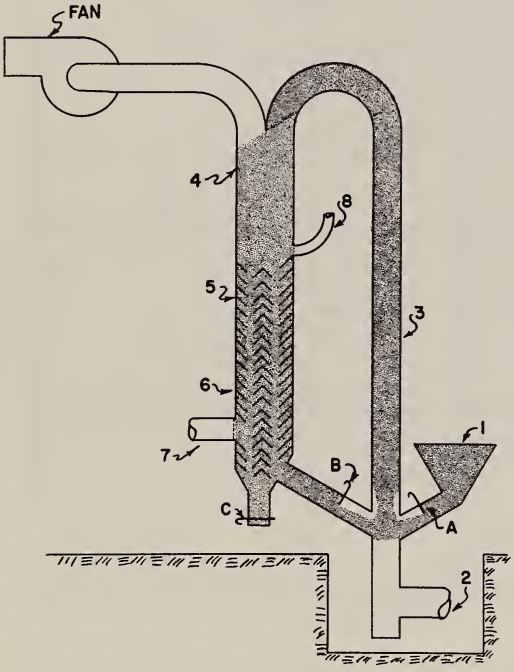

Figure 16.--Experimental (Belo-Russian) grain dryer.

Damp grain from the bunker (1), (fig. 16) is fed through slide A into the hot gas-air mixture coming from heater (2). The grain is drawn upward into the drying tube (3) and enters the grain separator (4) while the used gasses are evacuated through the fan to the atmosphere. The grain falls into a column consisting of two parts; the zone of intermediate cooling (5) and the zone of final cooling (6). Cooling air enters (7) and is exhausted at (8). Some of the grain returns through slide B to the drying tube and some is let out through slide C. The amount of grain recirculated depends on the initial grain moisture and the final moisture desired. Reportedly, the moisture content of the grain is reduced by 1 1/2 percent by one passage through the dryer with a drying air temperature of 130° to 150° C (266° to 302° F.). The Soviets hope to obtain a drying rate of 50 tons of grain per hour with a 6-percent reduction in moisture. They indicated, however, that more research is needed to obtain better uniformity of drying and to increase the efficiency of the process.

The Soviets also have done some research on vacuum drying of grain. They find the same disadvantages that we have found, namely, the great expense for the needed equipment, increased power requirements, difficulty in obtaining hermetic tightness, and the limited use for such dryers.

They also have conducted limited research on the use of infra-red rays in drying grain. The researchers found, on irradiation with air ventilation, that a considerable temperature gradient (up to 75° C. per Cm) is created in the grain kernels which resists the movement of moisture from the center of the kernel to its surface. They concluded that because of the neglible penetration of infra-red rays through grain layers, that it would be more useful to apply infra-red rays in combination with air heated to a moderate temperature, thereby using the energy of the infra-red rays for quick heating of the grain.

The basic flour milling processes in the Soviet Union are similar to those in the United States. All mills constructed in recent years are pneumatic and many older ones have been converted. Apparently 70 to 80 percent of all flour is milled in pneumatic mills. We were told that no flour mills in the Soviet Union use air classification or turbo or impact milling. The Soviets indicate that they are keeping abreast of the progress in these areas of milling.

All phases of flour milling operations are standardized in an operating handbook. This book contains detailed instructions for the organization and management of plant personnel and plant operations, including receiving and binning wheat; preparing grist for delivery to the mill, wheat cleaning and tempering; mill flow, machines and their operating speed; products manufactured; flour standards, and handling finished products. 9/

Soviet engineers in the Promzernoproyekt, Moscow, design and plan all of the mills. Apparently they have standardized their design for flour mills. Capacity may vary from 60 to 400 tons of wheat per 24 hours, to fit existing conditions, and the standard designs will apply. There are indications that the Soviet engineers have decided that a milling unit of 400 tons (approximately 6,500 cwts.) capacity is the maximum for best operation. The newest and most modern Soviet mill (Moscow Milling Combine No. 4) will house four of these 400 ton units as does the operating Leningrad mill. The mills are well designed but frequently indicated crude construction and machinery installation. Each mill is located primarily according to local demand. For this reason all mills receive about the same quantity year after year. Only the supply sources change as production varies.

Table 16 shows the flour mills and milling combines seen or discussed during the course of our visit.

Incoming wheat is binned according to:

Vitreousness - above 60%, 40 to 60%, and below 40%.

Moisture - below 14%, 14 to 15.5%, 15.5 to 17%, and over 17%.

Test Weight - above 750, 750 to 690, and lower than 690 hectoliter weight.

Gluten consistency - below 20%, 20 to 25% and over 25%.

Standards for wheat delivered to the mills' cleaning department are said to include moisture, weed seed admixture, other grain, quantity and quality of wet gluten; also said to be free of off odor, sprouted grains, foreign material or other contamination.

Cleaning machines in the mill include the usual separators, disc machines, scourers, aspirators, and wheat washers. The scourers were both the abrasive and the steel cylinder type. The millers use the ash reduction in whole wheat as a measure of the degree of scouring. They indicate that abrasive scourers may lower the ash content .03 - .05 percent and steel cylinders .02 - .03 percent. In one mill where scourer tailings were examined, it consisted of much beeswing and surface dust.

Most of the Soviet mills wash the wheat prior to milling. They usually use about 2 liters of water per kilogram of wheat. The wash water is filtered and the material collected is dried and used in feeds.

Wheat usually remains stationary during the tempering period. Moisture content of the wheat and length of temper time are varied according to vitreousness. No hot conditioning was observed in the mills visited although Soviet instructions indicate how it can be used. Most Soviet millers reported temper times of 8 to 12

9/ Order No. 409, Ministry of Bread Products, Sept. 9, 1958.

Table 16.--Name, location, wheat storage, and milling capacity of Soviet flour mills visited 1/

Name	Location	Wheat storage capacity	Milling capacity of grain per 24 hours
		Metric tons	Metric tons
Kirov Milling Combine	Leningrad	108,000	2,000
Kiev Milling Combine No. 1	Kiev	32,000	600
Odessa Seaport Elevator	Odessa	150,000	2/ 600
Novorossisk Seaport Elevator	Novorossisk	150,000	2/ 600
Moscow Milling Combine No. B	Moscow	24,000	550
Tsyuryupi Milling Combine	Moscow	40,000	
Mill 1 - Wheat			1,150
Mill 2 - Wheat			400
Mill 2 - Rye			900
Moscow Milling Combine No. 4	Moscow	72,000	1,500

1/ Excludes small farm mill.
2/ Not visited but discussed.

hours with the first break occurring at 15.5 to 16 percent moisture. One miller indicated a tempering schedule of 48 hours for durum wheat, 24 to 26 hours for winter wheat and 15 hours for spring wheat.

Each mill has its own corrugating department for its roller mills. Most of the rolls are 250 x 1,000 millimeters (9.84 x 39.37 inches) although a few are 1,250 millimeters or 49.21 inches long. Roller mills were observed to be similar to the familiar European built machines, although they were built in the Soviet Union.

In some of the mills these rolls were individually driven. Fast roll speeds ranged from 600 to 800 rpm. Differential speeds used were 2.5 to 1 for breaking, 1.5 to 1 on middlings and sizings, and 1 to 1 on the germ system.

First break rolls are dull to dull for vitreousness higher than 60 percent sharp to dull for vitreousness of 40 to 60 percent, and sharp to sharp for vitreousness of less than 40 percent. Second, third, fourth, and fifth breaks are made with rolls running sharp to sharp. It was stated that the break rolls are corrugated 4 to 6 cuts per centimeter and that almost all of the reduction rolls are corrugated 10 to 11 cuts per centimeter.

Information collected at the mills visited revealed that linear roll surface varied from 89 to 100 kilograms of wheat per centimeter (90 kilograms equals 0.25 inches per cwt. per 24 hours). At the School for Flour Millers in Moscow, 105 kilograms per centimeter (0.216 inches per cwt. per 24 hours) was claimed. Tne Director of the School also said that he was informed that in the United States the surface attained is only 30 to 35 kilograms of wheat per centimeter (35 kilograms equals 0.575 inches per cwt. per 24 hours). After converting our information to equivalent units, our milling expert indicated that our out turn is only slightly less than that attained in the Soviet mills.

All sifters were similar to our "Richmond" type; that is, the stacked sieves are not enclosed in sifter boxes. They were all individually driven and suspended by wire cables. Silk or nylon was used for bolting clothes.

Purifiers were stacked two high and did not have hopper bottoms. They were of wooden construction and appeared to be clumsy.

Dust collectors were totally enclosed cloth filters and cyclones.

Flour Standards and Yields

Generally speaking, all flour produced in the Soviet Union meets the requirements of one of the grades prescribed in the Soviet flour standards (tables 17 and 18). However, in some mills the highest grade and the No. 1 grade flours are combined and in some other mills a lower-grade flour is produced and used in dark bread.

Milling techniques used in the Soviet Union appear to yield the amounts of flour shown in table 19.

Each of the mills visited had wheat and flour laboratories which made grade and baking tests. These laboratories occasionally were located in older buildings or partly in the basement but they were well staffed and very well equipped. In fact, there was much extra equipment which duplicated the same test with a different method.

Flour Handling

Bulk storage and bulk delivery of flour is in its infancy. However, it is expected to gain rapidly as soon as bakeries become equipped to handle flour in bulk. The few bulk trucks now in use are discharged either like a dump truck or by

Table 17.--USSR wheat flour standards

Factor	"Highest grade"	Grade No. 1	Grade No. 2
Moisture, % (maximum)	15.0	15.0	15.0
Wet gluten, % 1/ (minimum)	28	30	24
Ash, % 1/ (maximum)	0.55	0.75	1.25
Material over 43 mesh per cm. sieve, % (maximum)	5.0	25.0	--
Material over 35 mesh per cm. sieve, % (maximum)	0.0	2.0	--
Color	2/	2/	

1/ Calculated on a moisture-free basis.
2/ Arbitrary color values based on a protoelectric reflectance meter of Russian manufacture and similar to the Kent-Jones Color Grader.

Table 18.--USSR rye flour standards

Factor	Grade No. 1 87% extraction	Grade No. 2 95% extraction
Moisture, % (maximum)	15.0	15.0
Ash, % 1/ (maximum)	1.45	1.93
Material thru 38 mesh per cm. sieve, % (min.)	98	--
Material thru 24 mesh per cm. sieve, % (min.)	--	98
Material thru No. 9 silk bolting cloth, % (min.)	60	--

1/ Calculated on a moisture-free basis.

Table 19.--Approximate yields of flour in the Soviet flour mills

Grade of flour	Odessa Mill	Tsyuryupi Moscow
	Percent	Percent
Highest	11	) 62
1st	40	)
2nd	26	14
Farina	1	2
Total four	78	78
Byproducts	22	22

means of a built-in Redler-type conveyor.

Flour is usually packed in 70-kilogram jute bags. The bags are recleaned and used about 4 or 5 times, and are then used for feed. Automatic scales and vibrators to compact the flour were in use. In one mill, a man operated two packing machines and a woman the sewing machine. The two people packed and sewed 1,200 bags during an 8-hour day. In another mill one woman did both the packing and sewing, and was said to handle 1,200 bags during an 8-hour day.

In one of the mills we visited, 15 percent of the output was packed in consumer size 2-kilogram boxes. They predicted that by 1962, 50 percent of this mill's output will be in consumer packages.

Flour is not now being enriched in the Soviet Union. We were told that they plan to begin enriching flour with vitamins and minerals late in 1961. Likewise, Soviet millers do not bleach their flour.

Soviet millers age the flour before use. They also attempt to stay on old wheat grist for at least 2 months after harvest.

All Soviet mills were very clean--almost no visible dust. Likewise, they were completely equipped with safety covers and devices. With the exception of one small farm mill, there was no evidence of insect or rodent infestation.

Apparently Soviet mills operate three shifts each day unless the mill is closed. They close each mill for one 8-hour shift each 10 days for maintenance work. They also close each mill for one month each year for repairs and overhauling. This time is also used to give the workers their one month vacation with pay.

Although we were told that there is a shortage of flour milling capacity in certain areas, this capacity is not scheduled to increase very much by 1965 (table 20). The Soviets are now producing a compact flour milling unit for milling use on the farm and in small cities (fig. 17).

BAKERIES

Because of our numerous interests, our shortness of time, and the fact that another team (the food processing team, in the Soviet Union at the same time) visited Soviet bakeries, we did not visit any bakeries. We did see a short film on bakery operations and discussed it briefly.

We were told that nearly all bread baking in the larger cities was done in large, efficient, mechanized bakeries. Little bread was baked in homes. In Moscow these large bakeries had a capacity of 500 tons per hour. They were reported to be highly mechanized using the batch method for firmentation and

Table 20.--Growth in flour milling capacity 1/ -- Selected years 1913-65

Year	Total	Graded
	(Million metric tons)	
1913	7.7	---
1940	18.3	8.4
1953	18.0	9.9
1959	23.9	16.2
1965	24.8	17.1

1/ Large mills only. Excludes production at farm mills, etc.

machines to size and cut. Little wrapping is required. In contrast, nearly all bread in the rural areas was baked in the home.

The food processing team reported that only bread and bread type rolls were produced in Soviet bakeries. Apparently, sweet rolls, cookies, pies and cakes are produced in the confectionery or some other industry. The team saw many varieties of these items in its visit to retail stores in Moscow.

FEED MIXING

The feed milling and animal nutrition industries appear to be much behind our own. The lag appears to be more from a nutritional and transportation standpoint than in technical equipment and plant design. The old industry was for the most part located adjacent to the flour mills and was tied to the flour mill byproducts. Additional large and small mills have been located near to the areas of feed demand but two of the farms we visited reported that all mixed feeds came to them from as much as 700 miles away and that they also shipped grain to these mills for custom grinding and mixing.

We were informed that there are about 60 large and 2,000 small feed mills in the Soviet Union. But the Soviets all hastened to add that while the industry was retarded it would advance rapidly in the next 6 years (table 21).

Table 21.--Planned percentage growth in mixed feeds production capacity, 1959-65

Year	Total feeds mixed	Protein and vitamins added
	Percent	Percent
1959	100	---
1960	140	100
1961	153	117
1962	164	144
1963	174	172
1964	185	207
1965	200	250

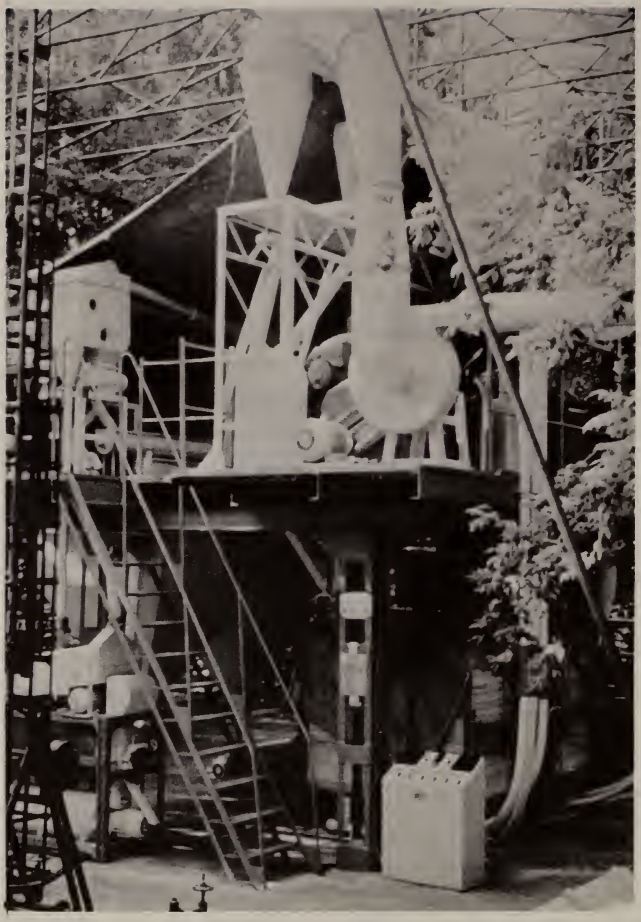

Figure 17.--Compact flour milling unit now being constructed for use on State and Collective Farms, and trucks loading bagged flour at a Moscow mill.

Table 21 shows the rapid growth planned in total feed mixed and protein and vitamins added. Only for total feeds mixed and for one year, 1959, did these data show an actual tonnage. The plans are shown in percentages because of this fact; also because the Soviets definition of total feeds mixed is so inclusive. It includes the grinding and mixing of any two or more grains, wafers produced from straw or corn stalks, and more completely formulated feeds. Even with this definition their total tonnage of formula feeds in 1959 only approximated 25 percent of ours.

Table 22 gives contents of some of the cattle wafers produced in the USSR.

Some examples of mash feed formulas for poultry and diary cattle are shown in table 23.

These and other specific formulas are recommended by the Soviets but we were told that the availability of ingredients locally actually dictates the final formulas produced. All feed mills, large or small, mix "from the ground up" with little or no supplementation of local ingredients. This undoubtedly is the result of transportation problems or the inadequate knowledge of the advantages of fortified feeds, presumably the former. We were told that they have been adding antibiotics, vitamins, and minerals (no hormones) for nearly 2 years. This must have been on a research basis or in trial plants because the formulas we saw for the Krasnodar Krai plant, in books of recommended formulas, and even in the Exhibition of Peoples Economic Achievements did not include these items.

A shortage of high protein ingredients appears to be a problem in the Soviet Union. Despite this fact the Soviets do not, at present, add much urea to their feeds. In the Krasnodar Krai plant it was added only in the winter. The major source of high protein in the Soviet Union is sunflower seed. Cottonseed is another source and they also talked about a pea or bean called "Nuttia" which is ground whole for poultry and pig feed.

Again the equipment for receiving, mixing and weighing in the plants is similar to ours. It consisted of separators, metal holding bins, grinders (hammer and attrition), equipment for mixing and pelleting wafers. However, it appears that batch mixing is not common. Percentage line-mixing with a screw conveyor is used not only in the large mills, but also in the compact stationary units. They plan to install these stationary units on each State and collective farm (fig. 18). Apparently they do not do nearly as much pelleting of mash feeds as our industry does.

Our team was told that the Soviets will be (1) adding antibiotics, vitamins, and minerals to many feeds; (2) coordinating the mixing of feeds between large and

Table 22.--Example of formulas of some Soviet cattle wafers

Item	Corn stalk and straw 3.5 - 4.5% Protein	Straw 3 - 4% Protein
	Percent	Percent
Corn stalk	40.0	---
Straw	43.5	83.5
Molasses	5.0	5.0
Bran	5.0	5.0
Grain screening	5.0	5.0
Chalk	1.0	1.0
Salt	0.5	0.5

Table 23.--Typical mixed feed formulas, Soviet Union 1/

Item	Swine 4 to 8 months	Sows gestation and suckling	Milk cows	Fattening cattle	Laying hens	Fattening chickens
	Percent	Percent	Percent	Percent	Percent	Percent
Corn	20	10	)	)	20	
Oats	20	20	) 20	) 10	20	2/ 36
Wheat bran	30	30	50	55	18.7	15.7
Sunflower meal	15	12			3/ 5	3/ 5
Cottonseed cake or meal			17	7		
Peas, lentils		10				
Corn feed meal		10				
Dry sugar beet pulp			10	10		
Barley meal	7			15		
Millet					15	
Barley					10	30
Fish meal	5				4	
Meat-bone meal		5			4	3
Rye						8
Chalk ($CaCO_3$)	2	2.3	2	2	3	2
Salt Na Cl)	1	0.7	1	1	4/ 0.3	4/ 0.3
Total	100	100	100	100	100	100
			Quality Indices			
Feed units in 100 kg. 5/	92	97	90	87	N.A.	N.A.
Amount of digestible protein in: grams	163	142	134	119	N.A.	N.A.
Raw fiber (%)	7	7	9	9	6.4	6.0

1/ Flour, Groats, Mixed-Feed Catalog, USSR Ministry of Grain Products, Moscow, 1956 and Technical Considerations and Formulas of Mixed Feeds - Concentrates for Agricultural Animals, Birds and Fish, Grain Publishers, Moscow, 1960.

2/ Hulled.

3/ Also linseed or soybean meal.

4/ Or oyster shell.

5/ The USSR feed unit is made equal to 1 kg. (2.2 lbs.) of average quality oats.

Figure 18.--Compact feed milling unit now being manufactured for use at State and Collective Farms.

small mills so that not all mills will mix feeds from the ground up, and (3) minimizing transportation while still supplementing local ingredients and fortifying complete feeds.

The shortage of high protein ingredients, the problems in transportation, the delay involved in reorganizing their feed mixing industry, the time involved in working out local variations in feed formulation, and the emphasis on dual purpose cattle and poultry appear to be some of the major problems involved in the attainment of their 1965 livestock production goals and of a continuing large livestock and poultry industry. They may also encounter a problem in getting complete rations fed to the livestock of the individual farm workers -- comparable to our problem in feeding farm poultry flocks.

SEED CORN CALIBRATING

The seed corn calibrating industry in the Soviet Union appears to be patterned after the seed corn plant imported from the United States. The plant our team visited was not this same plant but it was quite similar and was built in 1959.

It was housed in two buildings. The first building housed the receiving and storage (for 70 tons), dehusking, and hand selection or separating equipment. The second building housed the drying, shelling, and calibrating equipment. The calibrating equipment separated the corn kernels into 11 different fractions differentiated according to size and shape. This calibration is important in the Soviet Union because of the use of check row planting. Check row planting requires two kernels per hill and each of the 11 fractions is tested for the correct corn planter setting and each bag of seed delivered contains the correct setting instructions.

Although no complete study of wages paid to workers in the grain marketing industry was possible, this topic was discussed in nearly every one of our visits and although the type of information received varied, some general observations can be made. We also have some data from two recent reports of the U. S. Department of Labor, "Output per Worker in American and Soviet Industry" 10/ and "Purchasing Power of Workers in the USSR." 11/

As can be noted from table 24 there is a wide variation in earnings among the workers in the Soviet Union. And the chief engineers, engineers, technicians, mechanics, and common laborers in the grain marketing industry receive monthly earnings comparable to those of similar workers in other industries.

Farm workers on State farms are said to receive about the same monthly earnings as the collective farmers which are comparable to those of a semi-skilled worker. Naturally, money incomes cannot be compared directly since all workers do not receive comparable "free" benefits. All workers apparently receive education, recreation, medical care, and old age and disability protection. City workers pay 2 percent of their income as rent for a 1-room apartment and 4 percent for a 2-room apartment while farmers receive their home rent free and have a household garden plot (averaging less than 1 acre) for their own production and often are permitted to raise some livestock or poultry. Local sale of this produce is permitted.

The productivity of Soviet workers in nearly all industries appears to be much lower than that of the workers in the United States. 12/ This can be noted in the following excerpt from the report:

Agriculture-related branch of industry	Yearly output per worker-USSR as % of U. S.
Meat	53.2
Milk and dairy products	53.0
Vegetable oil	30.3
Margarine	17.1
Flour	60.7
Macaroni	51.9
Bread and bakery products	147.4
Confectionery products	52.1
Beer	35.7

The Bread and Bakery Products Industry was the only one out of the thirty plus industries showing Soviet industry more efficient than ours. This unusual comparison may be due to making inadequate comparisons or by the fact that (1) only bread and bread type rolls are produced in Soviet bakeries, and (2) there are few small bakeries operating in the Soviet Union - all city bakeries are large and all bread in the rural and suburban areas is baked in the home.

On the other hand, our discussion of the Soviet flour milling industry probably indicates a much closer comparability than the above figures. This may also be due to the making of inadequate comparisons or to the fact that (1) our team was shown the better than average facilities, and (2) the "make work" philosophy noted in many instances outside the industries studied was carried over into the flour milling and possibly other industries as well.

Table 25 indicates that the average Moscow worker has to work much longer than the New York City worker to buy the basic consumer goods. "For potatoes, he has to work about 3 times as long; for butter 9 times; and for sugar, 21

10/ Monthly Labor Review, Sept. 1959, pp. 992-994.
11/ Reprint No. 2339 from the Monthly Labor Review, April 1960.
12/ Productivity of American and Soviet Industry, Monthly Labor Review, Sept. 1959, pp. 992-994. Based on an analysis made by the Soviets.

Table 24.--Monthly earnings of workers in the Soviet Union, 1960 1/

Occupation	Monthly earnings
	Rubles 2/
Scientist (Academician)	8,000 - 15,000
Minister (Government)	7,000
Opera star	5,000 - 20,000
Professor (Science)	6,000 - 10,000
Professor (Medicine)	4,000 - 6,000
Docent (Assistant Professor)	3,000 - 5,000
Plant Manager	3,000 - 10,000
Engineer	1,000 - 3,000
Engineer Milling Combine Novorossisk	1,400 - 1,500
Engineer Milling Combine Moscow	1,200
Engineer Milling Combine Odessa	900
Engineer Milling Combine Krasnodar	1,100 - 1,200
Average All Labor Milling Combine Leningrad	1,200
Chief Engineer Milling Combine Moscow	2,700
Packer Milling Combine Moscow	1,200
Mechanic Milling Combine Kiev	1,100
Technician Milling Combine Krasnodar	800 - 900
Common Labor Milling Combine Krasnodar	600
Common Labor Milling Combine Novorossisk	700 - 800
Common Labor Milling Combine Moscow	500
Worker, unskilled	270 - 500
Worker, semiskilled	600 - 900
Worker, skilled	1,000 - 2,500
Technician	800 - 2,000
Physician (head)	950 - 1,800
Physician (staff)	850 - 1,000
Teacher (high school)	850 - 1,500
Teacher (primary)	600 - 900
Collective farmer (average Stalin farm)	775
Collective farmer (range Stalin farm)	400 - 2,800
Collective farmer (average Red Star)	800

1/ Indented and underlined items represent information supplied by the Soviets to our team. The remainder of the information is taken from U.S. Department of Labor's "Purchasing Power of Workers in the USSR," Monthly Labor Review, April 1960, page 362.

2/ The official rate of exchange, as fixed by the Soviet Government, is 4 rubles equal $1.00. The actual purchasing power, however, is more accurately represented by the official tourist rate of 10 rubles equal $1.00.

Table 25.--Approximate worktime required to buy selected commodities at state-fixed prices 1/ in Moscow and at retail store prices in New York City, August 15, 1959

Commodity	Moscow price (in rubles) 2/	New York City price (in dollars) 3/	Approximate worktime 4/			Moscow worktime as a percent of New York City worktime
			Unit	Moscow	New York City	
Foods:						
Rye bread, 1 pound	2/ 0.59	5/ 0.215	pound	9 min.	6 min.	150
1 kilogram (2.2 lb.)	1.30	3/ .473	kilogram	19.5 min.	13 min.	
Potatoes, 1 pound	.45	.060	pound	7 min.	2 min.	350
1 kilogram	1.00	.132	kilogram	15 min.	4 min.	
Beef, rib roast, 1 pound	5.45	.757	pound	82 min.	21 min.	400
1 kilogram	12.00	1.665	kilogram	180 min.	46 min.	
Butter, salted, 1 pound	12.27	6/ .741	pound	184 min.	20.5 min.	900
1 kilogram	27.00	1.630	kilogram	405 min.	45 min.	
Sugar, 1 pound	4.27	.110	pound	64 min.	3 min.	2,100
1 kilogram	9.40	.242	kilogram	141 min.	7 min.	
Milk, at grocery, 1 quart	2/ 2.08	.273	quart	31 min.	7.5 min.	400
1 liter (1.06 qt.)	2.20	3/ .289	liter	33 min.	8 min.	
Eggs, 2d grade, per dozen	2/ 9.60	7/ .629	dozen	144 min.	17.4 min.	800
per 10	8.00	3/ .524	per 10	120 min.	14.5 min.	
Tea, 50 grams (1 3/4 ounces)	3.80	.200	(ounce	33 min.	5.5 min.	600
			(50 grams	57 min.	10 min.	
Mens's clothing:						
Shirt, cotton 8/	60.00	2.03	each	15 hr.	56 min.	1,600
Suit, wool, single-breasted, middle of price range	1,100.00	50.41	each	275 hr.	23 hr.	1,100
Shoes, leather oxfords, pair	245.00	15.10	pair	61 hr.	7 hr.	850
Women's clothing:						
Dress, street, rayon	294.00	10.00	each	73 hr. 30 min.	4 hr. 36 min.	1,600
Shoes, leather oxfords, middle of price range	230.00	11.21	pair	57 hr. 30 min.	5 hr. 10 min.	1,100
Stockings, nylon	32.00	1.35	pair	8 hr.	37 min.	1,300
Other commodities:						
Soap, toilet, 100-gram cake, (3½ ounces)	2.10	.105	each	31.5 min.	3 min.	1,050
Cigarettes, package of 20	9/ 1.80	.25	package	27 min.	7 min.	400
Vodka, pint	25.28	10/ 2.98	pint	6 hr. 19 min.	1 hr. 22 min.	450
½ liter (1.06 pint)	26.80	3.16	½ liter	6 hr. 42 min.	1 hr. 27 min.	

1/ Prices observed on the open market, where collective farmers sell their produce, were much higher in comparison with State store prices. For example, potatoes were 1.50 rubles per kilogram; beef, 25 rubles per kilogram; and eggs, 15 rubles for 10. "Purchasing Power of Soviet Workers," Monthly Labor Review April 1960, page 362. 2/ Moscow prices in State stores, based on information appearing in the Soviet press; the prices for pound, quart, and dozen were calculated from Moscow prices for kilograms, liter, and 10 eggs, respectively. 3/ New York City prices in retail stores were collected by the Bureau of Labor Statistics; the prices for kilogram, liter, and 10 eggs were calculated from New York City prices for pound, quart, and dozen, respectively. 4/ Worktime figures for Moscow were computed on the basis of estimated average gross earnings of 4 rubles per hour of Moscow workers in manufacturing, a figure that is consistent with the Bureau of Labor Statistics' estimate of about 800 rubles a month. New York City worktime figures were computed from BLS retail prices and earnings in mid-August 1959 of $2.17 per hour of production workers in manufacturing in New York City. 5/ For white bread. 6/ First quality (92-93 score). 7/ Large eggs, grade A. 8/ Lowest priced shirt in Moscow. 9/ Brand name: Avtozavodskie. 10/ Spirit blended whiskey.

times. The worktime required to buy clothing is 8 to 16 times more in Moscow than in New York City, and reflects a clothing shortage in the Soviet Union. However, as previously indicated, this shortage is not as great as it was in 1953, when the worktime required to buy clothing in Moscow was 10 to 20 times more than in New York City." 13/

ITEMS OF POSSIBLE VALUE TO OUR GRAIN TRADE

Different practices and equipment in the grain trade were occasionally observed in the Soviet Union from those customarily observed in the U. S. Some of these practices and equipment might prove to be of value; however, further research and discussion is needed before the advantages and disadvantages of each of the following items can be assessed:

1. The limitation of the moisture content of export wheat to a maximum of 14.0 percent and the recleaning of all wheat intended for export.

2. The establishment of a special grade for "strong wheat" (or some other name) particularly to attract the export trade.

3. The use of a system of premiums and discounts in the prices paid to farmers for grain, based on moisture content and possibly other factors.

4. The use of a more objective method for determining vitreousness in wheat.

5. The use of a suction grain probe and automatic delivery of samples to a divider in the laboratory. This would be particularly applicable to sampling trucks at country elevators.

6. Determination of some factor related to protein content or gluten quality in all wheat inspection and showing this as supplementary information on inspection certificates.

7. Development of winter durum wheat varieties suitable for production in our winter wheat areas.

8. Production of high-oil-content sunflower seed, when and if vegetable oils are not surplus commodities.

9. The use of "Phillipie" buckets in elevating legs for more adequate filling and discharge at higher belt speeds.

10. A self propelled grain loader for picking up grain from flat storage or grain piled on the ground and loading it onto trucks or other vehicles.

11. More complete dust control systems in grain elevators for example, covered horizontal belt conveyor systems.

12. Two and three stage tower grain dryers for varying drying temperatures.

13. Belo-Russian dryer where the grain is dried by stages in a semi-suspended state.

14. Additional advances in mechanization of grain elevators and flour mills.

15. Prompt translation of important foreign scientific articles and books.

13/ See footnote 12.

All-Union Selection and Genetics Institute im T. D. Lysenko

Work at this institute is designed to increase the yields of grains and forages primarily through the development of new varieties which are drought resistant, cold resistant, and offer good quality

The Institute does not have a large staff but it was working on 30 new types or varieties of agricultural plants, including wheat and corn. Most of the work was on winter wheat varieties, but they were also working on 2 male sterile hybrid corn varieties. Some of their most interesting winter wheat varieties and the properties claimed for them are:

Odessa No. 3 (T. vulgare). Resistant to drought, winter killing, smut, and insects. Good baking quality.

Odessa No. 16 (T. vulgare). Resistant to winter killing and lodging, high protein content. Unusually strong baking quality.

Odessa No. 21 (T. vulgare). Large kernels. Resistant to winter killing and lodging. High yield, good baking quality.

Odessa Beardless (T. vulgare). High yield, lodge resistant, large kernels, 100% vitreousness, good baking quality.

Michurinka (T. vulgare x. T. durum). Considered to be a winter durum wheat. Resistant to -14° C. High yield, very high protein content. A new type of wheat said to be good for both bread and macaroni. It might be interesting to try this wheat in the United States.

Krasnodar Scientific Research Institute of Agriculture

Work at this Institute is designed to develop methods of increasing the yields grains and forages in the Krasnodar Krai. Until recently this Institute had merely been a small selection station. Its expansion into an institute reflects the fact that the Odessa varieties are not suited to the Krasnodar area because of different climates and black soil depths. A major proportion of the work at this Institute also had to do with winter wheat and corn varieties.

New winter wheat varieties developed at the Agricultural Research Institute at Krasnodar and adapted to that area include the following:

Beardless No. 1 (T. vulgare). Very large kernels, 1,000 kernel weight is 45-48 g. Lodge resistant, more kernels per head, high protein content.

Earliest No. 3b (T. vulgare). Fulcaster x Argentine Klein No. 33. Very high protein content.

This institute is also developing new hybrid varieties of corn for the area. New recently developed hybrids are:

Krasnodar Hybrid #4 (for grain)

Krasnodar Hybrid #5 (for grain)

"Synthetic" Hybrid 1/49 (for silage)

Male sterile strains of corn producing no pollen are used as the female parent in the production of hybrid seed corn, thus eliminating the need for detasseling.

Grain sorghums breeding work is being conducted at a station 250 km (156 miles) southeast of Krasnodar. This station was not visited.

We were informed that promising new varieties of grain, before being released for production, are tested at experiment stations and selected State and collective farms usually for at least three years before acceptance or rejection. New varieties of unusual merit are sometimes released in less than 3 years. There are about 1,200 such testing stations in the USSR, most of them on State and collective farms. Seed of approved varieties

is produced under the supervision of agronomists of research institutes in order to assure purity of strain. On a rotational basis each State and collective farm is furnished a new supply of certified seed grain every 5 years. In the intervening years the State and collective farms produce their own seed grain.

The impression was obtained that grain breeding work in the USSR is being carried on by very competent scientists and that very modern methods are used in grain seed production. None of the team members, however, were experts in these fields.

Promzernoproyekt

The State Planning Institute for Flour Milling and Groats Industry Enterprises, Elevators and Warehouses (Promzernoproyekt) was visited in Moscow prior to visiting storage facilities in various parts of the Soviet Union. This Institute is responsible for developing designs for elevators, and flour and feed mills, and the machinery and equipment needed for these facilities. It also helped to plan the location of the facilities, and for determining the best type and size of installation for each location. The Moscow office with some 1,800 employees develops typical construction plans and designs and furnishes the necessary engineering data. Offices in five other cities put these plans and designs into actual use. The local governments are not required to follow the recommendations furnished by the Moscow office but we were led to believe that they generally do follow them. Although considerable information was obtained at this meeting it would have been beneficial to have had a second meeting with the officials of the Planning Institute following the visits to the various storage facilities.

All-Union Scientific Research Institute of Grain and Allied Products

The All-Union Scientific Research Institute of Grain and Allied Products was visited after returning to Moscow. The work of this Institute includes studies of new and improved methods of preserving, drying, cleaning, and ventilating stored grain. This was a very worthwhile visit. It was disappointing, however, that a number of members of the Department were not available and some laboratories were closed. Meetings with U. F. Samochetov, Engineer and Deputy Chief of the Laboratory of Grain Drying and with Mr. Melnik, who is conducting studies on the aeration and ventilation of stored grain, were particularly interesting from an engineering standpoint.

Several publications on elevator design, grain drying, and aeration were received. However, several publications and plans that we had requested were not forthcoming for one reason or another.

Much of the material obtained at this Institute has been incorporated into the pertinent sections of this report.

State School for Flour Millers

This Institute offers a 2-year course leading to the degree of Master Miller. About 100 students are taking this course and each year about 50 students graduate. Prerequisities for the course are 10 years of schooling plus at least 3 years of practical experience in a flour mill. An entrance examination is required and there are two or three applicants taking this examination for each one accepted.

Candidates for admission into this school are recommended by the mills from among their most promising young employees having the necessary prerequisites. Students admitted into the school are paid by the mills for which they worked and throughout the 2-year course they receive the same pay that they received at the mill. After graduation they usually return to work as Master Millers in the same mills that employed them previously. Each mill has at least one Master Miller and the larger mills have several.

The school has a flour mill with a capacity of 150 tons of wheat for 24 hours. Training at the school consists of about 50 percent theoretical study and about 50 percent practical operation. Training is provided in cereal chemistry and experimental baking. The school also has special classes for engineers and feed millers.

Moscow Technological Institute of the Food Industry

This Institute offers training for technical personnel in grain elevators; flour and feed mills; bakeries; sugar refineries; macaroni, confectionery, vitamin, and wine manufacturers; and other food industries. The institute has four departments: (1) Foods in general, (2) milling and elevator, (3) mechanics, and (4) economics. Full-time as well as evening courses are given. There are about 3,600 full-time students and 800 evening students. Two degrees are given: (1) Candidate of Science, and (2) Doctor of Science. Prerequisites for admission to the Institute include a university degree and 2 years of practical experience in some branch of the food industry. A 2-year course leads to the Candidate of Science degree. The faculty consists of 30 professors, about 200 assistant professors, and 70 assistants. Faculty members are permitted to devote 50 percent of their time to independent research. Candidates for the Doctor of Science degree are eligible to be assistant professors. Professors must already have Doctor's degrees.

Prof. W. Kretovich is head of the Division of Biochemistry and Cereal Chemistry. He is the author of a well-known book on grain storage that has been translated into English by the U. S. Department of Agriculture. One of his woman graduate students from Bulgaria is working with our sedimentation test for wheat quality developed by the U.S.D.A. and is trying to develop a micro method for use in wheat-breeding work.

Moscow Agricultural Academy im K. A. Timiryazev

This Academy offers the degrees of Candidate of Agricultural Science and Doctor of Agricultural Science. Courses are offered in agronomy; soils; agricultural chemistry; animal husbandry; horticulture; and agricultural economics; education; and engineering. The Academy has about 7,000 students. All undergraduate students are required to work 5 or 6 months a year, usually from April until September, on a State or collective farm. The degree of Doctor of Agricultural Science is awarded only after the candidate has completed research that is accepted as being of significant national benefit to agricultural science.

The Academy has 1,700 acres of land devoted to forestry, irrigation, vegetable, fruits, selection and genetics, field crops, and livestock research; as well as to arboretums, dorms, and a Botanical garden. In addition it has six State experimental farms which it uses for experiments and to give students practical experience.

The three education institutes visited appeared to be staffed with competent faculty members and to be well equipped with laboratory and other teaching facilities. In all instances an unusual amount of emphasis is placed on the value of practical experience, both as a prerequisite to entrance and as an adjunct to the courses of study offered. Research is conducted both by graduate students under the general supervision of faculty members and independently by faculty members. Greater emphasis appears to be placed on applied research than on basic research.

ITINERARY

June 28.	Arrived Moscow. Met with Mr. Wm. Horbaly, Agricultural Officer, Department of State, U. S. Embassy.
June 29.	Moscow. Met with our host, The State Scientific and Technical Committee, and with State Committee of Grain and Grain Products.
June 30.	Moscow. Meetings with Promzernoproyekt and Ministry of Agriculture. Night train to Leningrad.
July 1.	Leningrad. Visited Confectionery Factory No. 1.
July 2.	Leningrad. Visited Kirov Milling Combine. Returned to Moscow by night train.
July 3.	Moscow to Kustenay, Kasakhstan, Siberia by plane.
July 4.	Kustenay. Visited Kustenay Elevator.
July 5.	Kustenay. Visited Aman-Karagai Elevator and Zatobolskiy Sovkhozy. (State Farm).
July 6.	Kustenay to Kiev via Sverdlovsk and Moscow by plane.
July 7.	Kiev. Meeting with Ukrainian Ministry of Grain and Grain Products and Kiev Milling Combine No.1.
July 8.	Kiev to Odessa by plane.
July 9.	Odessa. Visited Odessa Seaport Elevator and Odessa Milling Combine No. 2.
July 10.	Odessa. Visited Stalin Kolkhozy (Collective Farm).
July 11.	Odessa. Visited All-Union Selection and Genetic Institute and final meeting with Oblast Committee of Grain and Grain Products.
July 12.	Odessa to Novorossisk by ship.
July 13.	Visited Novorossisk Seaport Elevator and drove to Krasnodar.
July 14.	Krasnodar. Met with Krasnodar Krai Committee for Grain and Grain Products and Krasnodar Scientific Research Institute of Agriculture.
July 15.	Krasnodar. Visited Krasnodar Milling Combine and then Red Star Kolkhozy. (Collective Farm).
July 16.	Krasnodar. Met again with Krasnodar Krai Committee for Grain and Grain Products. Krasnodar to Adler by plane, Adler to Sochi by automobile.
July 17 and 18.	Sochi. Rest and relaxation. Talked with Chairman of the local grain and grain products committee.
July 19.	Sochi to Moscow by plane.
July 20.	Moscow. Visited State School for Flour Millers and Moscow Milling Combine No. 3.
July 21.	Moscow. Visited Tsyuryupi Milling Combine and Moscow Food Technological Institute.
July 22.	Moscow. Visited Moscow Agricultural Academy im K.A. Timiryazev and Exportkleb.
July 23.	Moscow. Visited Moscow Milling Combine No. 4 and USSR Exhibition of Peoples' Economic Achievement.
July 25. (Sunday)	Moscow. Visited Kremlin and attended Moscow Baptist Church.
July 26..	Moscow. Final meetings with State Committee for Grain and Grain Products and our host the State Scientific and Technical Committee.
July 27.	Moscow to Helsinki by plane.

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